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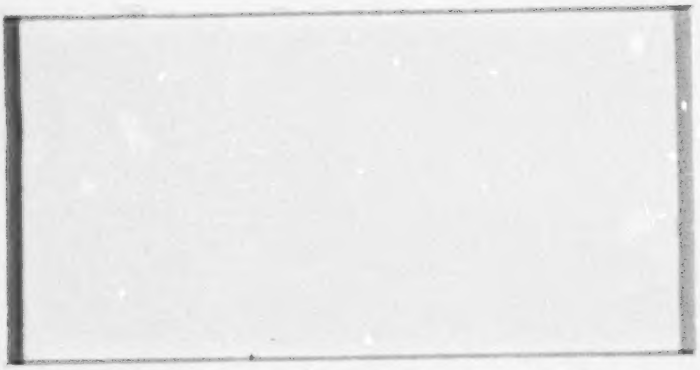

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POST-OPERATIONAL FUEL STORAGE GROUNDWATER QUALITY STUDIES-1982 THUNDER BAY TGS EXTENSION

Report No 83-442-K

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ABSTRACT

Data on the physical and chemical characteristics of groundwaters from the fuel storage areas at Thunder Bay TGS, for 1982, are presented in this report. The 1982 data on the groundwater quality are similar to those acquired during the past three years. The pattern of high sulphate levels around the bituminous coal pile observed in the past is also evident in this year's data. However, in 1982, increases in iron and sulphate levels also occurred in waters around the lignite pile. Because the pH and sulphate levels in waters on opposite sides of the drainage ditches are inconsistent, no conclusion can be reached at this time on the effect of the drainage ditches on water quality. Further monitoring appears required to show the real effect of the drainage ditches on groundwater quality.

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To Dr. W.R. Effer
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POST-OPERATIONAL FUEL STORAGE AREA GROUNDWATER QUALITY STUDIES-1982 THUNDER BAY TGS EXTENSION

INTRODUCTION

A survey of groundwater quality in the vicinities of the bituminous and lignite coal piles at Thunder Bay TGS Extension was conducted during 1982. This survey is a continuation of the pre-operational groundwater surveys conducted by London Monenco Consultants (LMC) during 1979/1/, and by Ontario Hydro during 1980 and 1981/2,3/. The data obtained during the 1982 survey are summarized in this report.

The purpose of the pre-operational (pre-1982) surveys was to obtain baseline data on the local hydrology and on groundwater chemistry. The 1982 survey, the first of a planned three-year design verification program, was conducted to obtain 'post-operational' data. Both sets of data are required to evaluate environmental impacts due to:

(i) The placement of a lignite coal storage pile, the coal transfer activities north of the plant, and the continued behavior of the bituminous coal pile.

(ii) The construction of drainage ditches along the perimeters of the lignite coal storage area and the bituminous coal pile, as shown in Figure 1, to collect and hold, in a pond, surface run-off to minimize infiltration of leachate to the groundwater.

The accumulated data will also be used to identify any future changes in groundwater quality and if and when any corrective action should be taken.

The pre-operational and the 1982 post-operational surveys were conducted at the request of Ontario Hydro's Environmental Studies and Assessments Department on behalf of the Thunder Bay Project.

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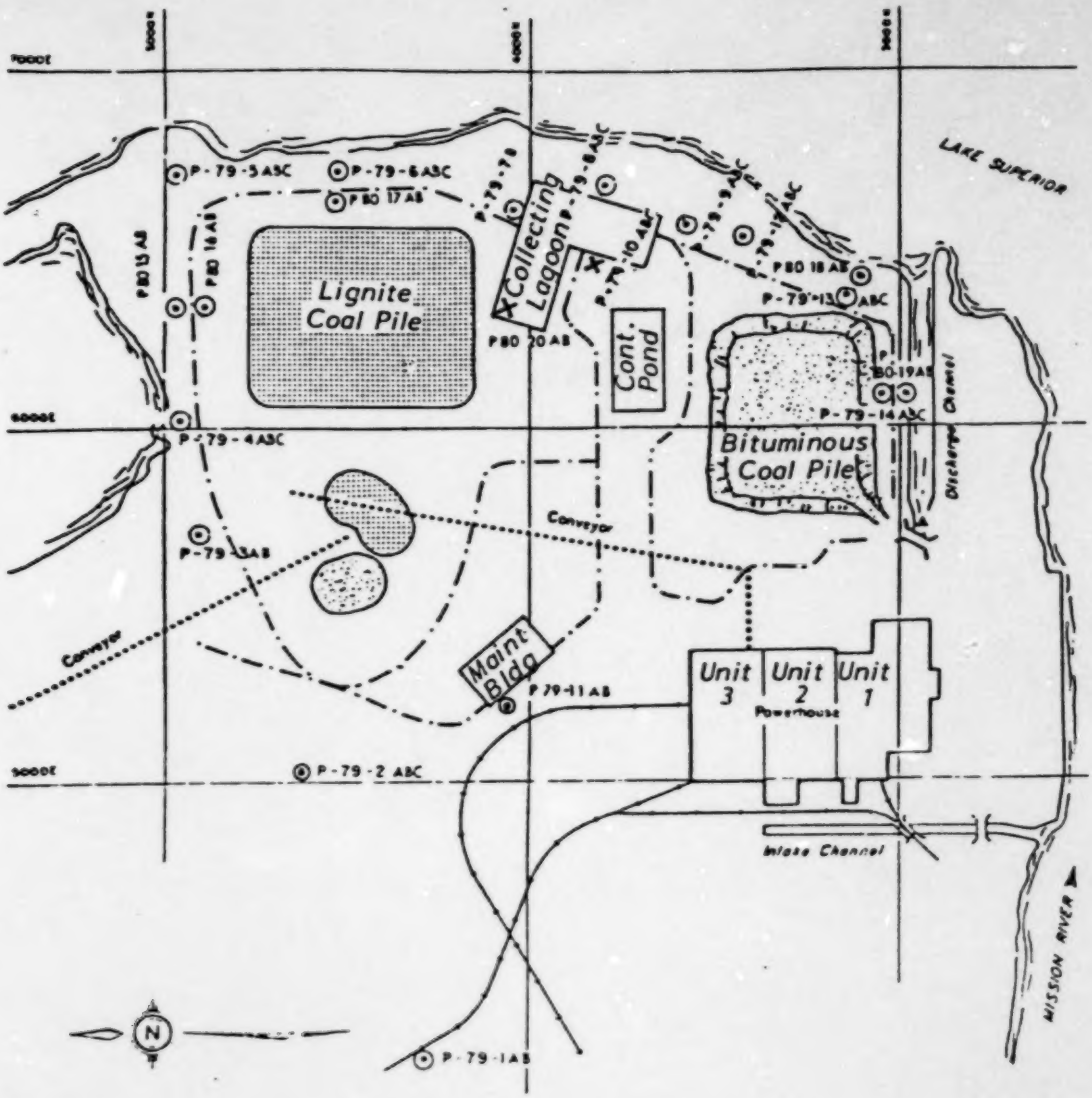

FIGURE 1

PIEZOMETER, PONDS, DITCHES
AND FUEL STORAGE LOCATIONS
THUNDER BAY TGS EXTENSION
1982

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HISTORY OF THE FUEL STORAGE AREA - TO END OF 1982

The following is a brief outline of the main events in the history of the 'Fuel Storage Areas' shown in Figure 1.

(1) The coal pile for Unit #1 (sub-bituminous coal) has existed since the 1950's.

(2) Coal (lignite) for Units #2 and #3 has been stockpiled in the 'lignite storage area' since late 1980. New lignite was stockpiled beginning in early 1981.

(3) Ditches to intercept coal pile drainage (Figure 1) were completed in November 1981.

METHODOLOGY

To obtain the raw data needed to characterize the hydrology and the quality of the runoff and the natural groundwater in the coal storage areas the following procedures were used:

1. Piezometer and Water Level Surveys

Measurements of piezometer elevations and of water levels in piezometers were conducted during 1982 by Civil Research and TBTGS personnel. The levels are reported as elevations relative to the average lake shoreline level of 182.88 m (600 ft) for the Thunder Bay area.

2. Groundwater Sampling

Groundwater sampling by station personnel was scheduled for May, September and November. In general, the following water level measurement and sampling procedures were followed:

(a) Bailing
- Groundwater levels in each piezometer were measured and recorded. The water from each piezometer was bailed out with a hand-operated pump or vacuum pump.
- Four days later the water from each piezometer was bailed out again.

(b) Sampling
- One day after the second bailing 1 L of groundwater from each piezometer was collected into an acid cleaned LPE bottle.
- The water's pH and conductivity were measured immediately with portable pH and conductivity meters.

(c) Preparation - All samples collected were kept in a refrigerator at about 4°C.

- The samples were filtered as soon as possible using a 0.45 µm prewashed Millipore filter.

- A pretreated 500 mL LPE bottle was filled with the filtrate to which were added 2.5 mL of "ULTREX" HNO_3.

- A portion of the remaining filtrate was used for acidity and alkalinity determinations.

(d) Shipping - The remaining filtrate (from c) was kept at about 4°C in a cooler with ice packs, and shipped, together with the acidified samples, to Research Division, by Air Express, for analysis.

3. Groundwater Tests and Analysis

(a) Partial Analysis at TBTGS

The characteristics determined were pH, conductivity, acidity and alkalinity.

(b) Comprehensive Analysis - Research Division

Comprehensive chemical analyses of the groundwater samples were carried out by the Research Division. The characteristics determined are shown below:

pH	P as PO_4	Ba	Mn	Ni
Conductivity, mS/m	F	Al	V	Sn
Alkalinity	Ca	Si	Cr	Zn
Acidity	Mg	Th	Cu	As
SO_4	Na	Be	Mo	B
Cl	K	Fe	Ag	Pb
NO_3	Sr	Ti	Co	Se
				Cd
				Hg

(c) Analytical Methods

The analytical methods used were mainly those outlined in the Standard Methods for the Examination of Water and Wastewater, published by the American Public Health Association (14th Edition). Ion Chromatography, neutron activation and other instrumental techniques, currently in general use by the Analytic Section, were also used for some determinations.

4. Rationale

(a) Field Tests

Because some characteristics of natural waters change after sampling, pH and conductivity were measured in the field and acidity and alkalinity were determined in the station's laboratory.

(b) Comprehensive Analysis

Because of their complexity and time required, comprehensive analyses were carried out by the Analytic Section of the Chemical Research Department, Research Division.

(c) Parameter Significance

Of the parameters determined, pH, conductivity, acidity, alkalinity (total) and concentrations of SO_4 and Fe are considered as the main indicators of coal leachates. These parameters were used to distinguish between contaminated groundwaters and local surface waters.

The above indicators of coal leachates are common to both the bituminous and the lignite coals. However, the two types of leachates differ in their acidity and alkalinity levels. Leachates from bituminous coal are usually very acidic (low pH and low alkalinities). Leachates from freshly stockpiled lignite coal are usually alkaline (pH > 7 and low acidity)/3/.

Sulphate is regarded to be the most reliable indicator of the presence of bituminous coal leachates. High iron concentrations and low pH levels (high acidity and low alkalinity) are also indicative but they are more prone to modification on passage through the soil. The remaining parameters are less reliable contaminant indicators but do help in general characterization of water quality.

The main contaminant indicator parameters and other selected analytical data, including trace metals, that will be obtained in each subsequent year on the groundwater characteristics, will be presented in future summary annual reports in the form of graphs, tables and Piper plots to aid in identifying any changes that can be attributed to coal leachate seepage into the natural groundwater in the fuel storage areas.

RESULTS OF FIELD AND LABORATORY WORK CONDUCTED IN 1982

1. Piezometer Network Level Surveys

Piezometer elevation surveys were carried out by the Civil Research Department on June 9 and November 3, 1982. The

1982 results, together with those obtained from 1979 to 1981, are summarized in Table I. Locations of the piezometers are shown in Figure 1.

2. Groundwater Level Surveys

Measurements of groundwater levels in piezometers on the perimeters of the fuel piles were carried out in May, August, October and November. The results are shown in Table II.

Lake Superior water levels (daily means) for 1982, obtained from the Environment Canada, Annual Meterological Summary 1982, for location Station 10050, in Thunder Bay, are shown in Table III.

3. Groundwater Characteristics

The comprehensive analytical results obtained at Research on the groundwater samples taken on May 18, August 25 and November 18, 1982, are shown in Appendix A. The limited results obtained at Thunder Bay TGS are also included in the summary. However, although they were obtained on the same samples as were submitted for the comprehensive analysis the results are shown under a different date (one day after the actual sampling) to avoid computer problems in recalling the data in the future. The main groundwater characteristics are presented in Tables IV to VIII, in the discussion section.

DISCUSSION

1. Piezometer Reference Levels

Examination of all the data available on piezometer elevations (1979 to November 3, 1982) shows very little movement in the majority of the piezometers since they were originally installed. The greatest overall increases in elevations occurred in piezometers 20B (60 cm), 17B (47 cm), 12A, B and C (26, 36 and 29 cm), 9A, B and C (35, 35 and 37 cm) and 6A, B and C (10, 18 and 11 cm). The greatest decreases in elevations occurred in piezometers 17A (34 cm), 7C (19 cm) and 5C (15 cm).

Piezometers 20A and 20B were covered with coal at the time levels were measured so their 1982 elevations are not available. The large increase in elevation observed for piezometer 20B in 1981 cannot, therefore, be confirmed. The apparent concurrent overall loss and gain in elevations of piezometers 17A and 17B (-0.34 m and +0.47 m) is probably an error caused by possible interchange of the reference levels given for these piezometers in 1980. If these original elevations are reversed, the change in both piezometers is a gain of only 6 and 7 cm respectively.

The remaining overall increases of between 10 and 37 cm of piezometers 12ABC, 9ABC and 6ABC and decreases of 16 and 20 cm of piezometers 5C and 7C could be real.

TABLE I

FUEL STORAGE AREA - GROUNDWATER MONITORING PROGRAM - 1982
THUNDER BAY TGS EXTENSION

PIEZOMETER REFERENCE LEVELS
(1979-1982)

Piezometer Identification		Piezometer Reference Levels, m (Relative to Average Shoreline Level of 182.88 m)										
		Date Surveyed										
		(1) 1979	(1)(2) 1980	(3) Δ	(2) July 16/81	Δ	Nov 2/81	Δ	June 9/82	Δ	Nov 3/82	Δ
P79	1A	2.76	2.77		NA							
	1B	2.72	2.73		NA							
P79	2A	3.13	3.14		NA							
	2B	3.14	3.15		NA							
	2C	3.13	3.14		NA							
P79	3A	1.80	1.81		NA							
	3B	1.87	1.88		NA							
P79	4A	3.00	3.01		2.99	-0.02	3.05	0.06	3.01	-0.04	3.00	-0.01
	4B	2.98	2.99		2.94	-0.05	3.01	0.07	2.97	-0.04	2.95	-0.02
	4C	3.02	3.03		2.97	-0.06	3.04	0.07	2.99	-0.05	2.98	-0.01
P79	5A	3.50	3.51		3.42	-0.09	3.55	0.13	3.53	-0.02	3.52	-0.01
	5B	3.55	3.56		3.48	-0.08	3.61	0.13	3.59	-0.02	3.58	-0.01
	5C	3.61	3.62		3.52	-0.10	3.65	0.13	3.62	-0.03	3.46	-0.16
P79	6A	3.18	3.19		3.17	-0.02	3.30	0.13	3.29	-0.01	3.28	-0.01
	6B	2.96	2.97		3.00	0.03	3.14	0.14	3.15	0.01	3.14	-0.01
	6C	2.75	2.76		2.73	-0.03	2.87	0.14	2.87	0.00	2.86	-0.01
P79	7A	2.39	2.40		2.42	0.02	2.42	0.00	2.41	-0.01	2.41	0.00
	7B	2.73	2.73		2.72	-0.01	2.74	0.02	2.72	-0.02	2.71	-0.01
	7C	2.89	2.90		2.93	0.03	2.93	0.00	2.91	-0.02	2.70	-0.21
P79	8A	2.41	2.42		2.42	0.00	2.46	0.04	2.45	-0.01	2.44	-0.01
	8B	2.63	2.64		2.63	0.01	2.68	0.03	2.66	-0.02	2.65	-0.01
	8C	2.57	2.58		2.58	0.00	2.64	0.06	2.63	-0.01	2.63	0.00
P79	9A	2.10	2.11		2.38	0.27	2.37	-0.01	2.46	0.09	2.45	-0.01
	9B	2.09	2.10		2.43	0.33	2.43	0.00	2.53	0.10	2.44	-0.09
	9C	2.11			2.70		2.39	-0.31	2.49	0.10	2.48	-0.01
P79	10A	2.55	2.50		NA							
	10B	2.64	2.66		NA							
	10C	2.66	2.66		NA							
P79	11A	2.90	2.91		NA							
	11B	2.90	2.91		NA							
P79	12A	1.78	1.79		2.19	0.40	2.05	-0.14	2.08	0.03	2.07	-0.01
	12B	1.83	1.84		2.18	0.34	2.15	-0.03	2.19	0.04	2.19	0.00
	12C	1.88	1.89		2.08	0.19	2.17	0.09	2.18	0.01	2.17	-0.01
P79	13A	2.06	2.06		2.16	0.10	2.13	-0.03	2.17	0.04	2.16	-0.01
	13B	2.03	2.04		2.17	0.13	2.14	-0.03	2.15	0.01	1.94	-0.21
	13C	2.03	2.02		2.22	0.20	2.19	0.03	2.19	0.00	2.19	0.00
P79	14A	2.25	2.26		2.33	0.07	2.33	0.00	2.35	0.02	2.33	-0.02
	14B	2.20	2.21		2.34	0.13	2.30	-0.04	2.35	0.05	2.34	-0.01
	14C	2.25	2.25		2.37	0.12	2.29	-0.08	2.29	0.00	2.28	-0.01
P80	15A		3.60		3.47	-0.13	3.58	0.11	3.54	-0.04	3.53	-0.01
	15B		3.56		3.51	-0.05	3.61	0.10	3.58	-0.03	3.57	-0.01
P80	16A		3.38		3.26	-0.12	3.36	0.10	3.37	0.01	3.36	-0.01
	16B		3.31		3.34	0.03	3.43	0.09	3.45	0.02	3.44	-0.01
P80	17A		3.35		2.87	-0.48	3.01	0.14	3.02	0.01	3.01	-0.01
	17B		2.95		3.28	0.33	3.41	0.13	3.42	0.01	3.42	0.00
P80	18A		2.17		2.25	0.08	2.21	-0.04	2.21	0.00	2.21	0.00
	18B		2.17		2.24	0.07	2.20	-0.04	2.19	-0.01	2.18	-0.01
P80	19A		2.27		2.31	0.04	2.27	-0.04	2.24	-0.03	2.22	-0.02
	19B		2.66		2.70	0.04	2.66	-0.04	2.62	-0.04	2.61	-0.01
P80	20A		2.92		2.94	0.02	2.87	-0.07	-	-		
	20B		2.54		2.55	0.01	3.14	0.59	-	-		

(1) London Monenco Consultants Ltd., Baseline Report for Ontario Hydro Thunder Bay TGS Extension - Groundwater Monitoring Study - Coal Storage Area (B-2) Feb. 1980.

(2) Ontario Hydro Data. 1980 - from 15A to 20B. The remaining values are rounded 1979 LMC values.
1981 - NA = Not available.

(3) No change - Previous levels are the same (LMC) or original (OH).

Δ Change from previous levels (m).

TABLE II

FUEL STORAGE AREA - GROUNDWATER MONITORING PROGRAM - 1982
THUNDER BAY TGS EXTENSION

RELATIVE PIEZOMETER AND LAKE WATER LEVELS - 1982
(Relative to Average Shoreline Level of 182.88 m)

Piezometer Identification	Relative Water Levels in Piezometers (m)			
	Dates Measurements Were Taken			
	May 14/82	Aug. 23/82	Oct. 29/82	Nov. 9/82
P79 1A	1.22	1.28	1.29	1.27
P79 1B	1.28	1.13	1.27	1.21
P79 2A	2.11	1.75	-	-
P79 2B	2.09	1.75	-	-
P79 2C	2.09	1.78	-	-
P79 3A	0.68	0.55	0.37	0.56
P79 3B	0.73	0.65	0.66	0.64
P79 4A	0.46	0.57	0.69	0.58
P79 4B	0.51	0.56	0.70	0.59
P79 4C	0.51	0.56	0.69	0.60
P79 5A	0.17	0.33	0.59	0.46
P79 5B	0.18	0.42	0.60	0.49
P79 5C	0.18	0.54	0.61	0.35
P79 6A	0.23	0.43	0.60	0.43
P79 6B	0.23	0.41	0.58	0.49
P79 6C	0.20	0.40	0.57	0.46
P79 7A	-	0.16	0.09	0.00
P79 7B	-	0.15	0.10	-0.06
P79 7C	-	0.18	0.13	-0.24
P79 8A	0.24	0.15	0.10	-0.15
P79 8B	0.31	0.15	0.11	-0.11
P79 8C	0.38	0.18	0.18	-0.03
P79 9A	0.45	0.40	0.50	0.45
P79 9B	0.40	0.47	0.57	0.43
P79 9C	0.37	0.39	0.50	0.45
P79 10A	-	-	-	-
P79 10B	-	-	-	-
P79 10C	-	-	-	-
P79 11A	1.26	1.22	1.16	1.13
P79 11B	1.21	1.21	1.15	1.13
P79 12A	0.38	0.43	0.54	0.46
P79 12B	0.41	0.41	0.54	0.55
P79 12C	0.52	0.32	0.55	0.46
P79 13A	0.42	0.53	0.58	0.57
P79 13B	0.56	0.48	0.56	0.23
P79 13C	0.66	0.44	0.53	0.53
P79 14A	0.41	0.44	0.54	0.44
P79 14B	0.40	0.45	0.53	0.45
P79 14C	0.40	0.45	0.53	0.46
P80 15A	0.37	0.70	0.94	0.75
P80 15B	0.49	1.14	0.48	1.34
P80 16A	0.57	0.92	0.21	0.93
P80 16B	0.70	0.92	0.20	0.93
P80 17A	0.03	0.59	0.83	0.60
P80 17B	0.82	0.69	0.99	0.65
P80 18A	0.37	0.44	0.53	0.49
P80 18B	0.36	0.41	0.51	0.46
P80 19A	0.03	0.40	-0.04	0.46
P80 19B	0.66	0.44	0.53	0.49
P80 20A	-	-	-	-
P80 20B	-	-	-	-
Lake Levels (1)	0.09	0.30	0.38	0.40

(1) Relative Average Monthly Lake Levels (relative to 182.88 m). Taken from the Annual Meteorological Summary - 1982 - Station 10050, Thunder Bay, issued by the Canadian Climate Centre (Downsview), Atmospheric Environment Service, Environment Canada.

DAILY MEAN LEVELS MOYENNES JOURNALIERES DE NIVEAU D EAU

STATION 10060 THUNDER BAY CRT — TIME ZONE EST

DAY	MONTH	YEAR	MONTHLY MEANS	DAILY MEANS											HIGH/LOW	DAY	TIME	INSTANTANEOUS HT
1	10	1	82		18284	18294	18285	18281	18288	18279	18283	18281	18279	18272				
1	20	1	82		18280	18282	18283	18285	18282	18277	18281	18282	18282	18280				
1	31	1	82	182814	18281	18284	18278	18278	18279	18282	18288	18277	18281	18277	18280	H	2	2015	18304
				-0.07*												L	10	2045	18262
1	10	2	82		18280	18280	18277	18279	18278	18279	18277	18278	18278	18279					
1	20	2	82		18277	18277	18277	18280	18277	18276	18279	18279	18278	18277					
1	28	2	82	182774	18276	18277	18275	18275	18276	18275	18274	18278				H	15	100	18287
				-0.11												L	23	15	18263
1	10	3	82		18274	18273	18275	18275	18275	18274	18273	18273	18274	18276					
1	20	3	82		18274	18278	18274	18274	18277	18275	18275	18273	18273	18274					
1	31	3	82	182744	18274	18274	18277	18275	18273	18271	18273	18276	18275	18277	18273	H	30	1745	18287
				-0.14												L	11	1345	18265
1	10	4	82		18272	18279	18271	18275	18277	18277	18278	18279	18279	18278					
1	20	4	82		18278	18280	18277	18280	18282	18280	18278	18282	18281	18281					
1	30	4	82	182805	18283	18285	18285	18286	18284	18284	18285	18287	18287	18287		H	24	1545	18290
				-0.07												L	3	1530	18261
1	10	5	82		18287	18287	18289	18291	18290	18291	18295	18293	18293	18300					
1	20	5	82		18298	18295	18299	18299	18298	18299	18300	18303	18300	18300					
1	31	5	82	182974	18300	18300	18301	18301	18303	18302	18301	18301	18302	18301	18301	H	11	615	18318
				0.09												L	10	2330	18276
1	10	6	82		18302	18301	18303	18304	18302	18303	18305	18302	18302	18304					
1	20	6	82		18304	18304	18304	18305	18302	18305	18303	18303	18304	18303					
1	30	6	82	183032	18303	18302	18304	18303	18303	18303	18305	18303	18302	18302		H	7	630	18315
				0.15												L	8	945	18288
1	10	7	82		18303	18303	18302	18304	18305	18305	18306	18306	18305	18306					
1	20	7	82		18308	18313	18314	18313	18314	18316	18319	18317	18317	18318					
1	31	7	82	183123	18317	18316	18316	18319	18317	18317	18316	18316	18318	18317	18319	H	17	1015	18340
				0.24												L	9	1215	18296
1	10	8	82		18316	18318	18321	18319	18318	18319	18320	18320	18316	18317					
1	20	8	82		18318	18318	18319	18319	18319	18317	18317	18318	18318	18318					
1	31	8	82	183182	18319	18319	18319	18319	18318	18318	18316	18317	18319	18316	18318	H	3	1100	18338
				0.30												L	3	630	18305
1	10	9	82		18318	18317	18316	18320	18316	18318	18318	18320	18319	18319					
1	20	9	82		18319	18320	18318	18317	18318	18319	18319	18320	18319	18317					
1	30	9	82	183192	18319	18321	18320	18318	18320	18322	18319	18323	18325	18321		H	29	400	18336
				0.31												L	5	1015	18307
1	10	10	82		18318	18321	18320	18321	18320	18323	18327	18324	18325	18331					
1	20	10	82		18328	18327	18326	18326	18322	18323	18327	18326	18324	18321					
1	31	10	82	183257	18328	18329	18329	18330	18327	18328	18330	18329	18332	18328	18328	H	7	845	18338
				0.38												L	6	545	18307
1	10	11	82		18328	18327	18329	18328	18326	18328	18330	18326	18327	18330					
1	20	11	82		18327	18320	18329	18327	18332	18329	18330	18331	18331	18333					
1	30	11	82	183279	18326	18328	18326	18327	18326	18324	18328	18328	18327	18329		H	20	1815	18344
				0.40												L	12	945	18297
1	10	12	82		18327	18328	18328	18326	18325	18322	18322	18320	18326	18319					
1	20	12	82		18319	18323	18322	18321	18319	18320	18326	18323	18319	18318					
1	31	12	82	183220	18320	18322	18324	18320	18318	18324	18322	18316	18320	18322	18322	H	2	2315	18346
				0.34												L	28	815	18302

*Lake water levels. Difference between monthly means and average shoreline level of 182.88 m.

LAKE WATER LEVELS 1982 - ENVIRONMENT CANADA ANNUAL METEOROLOGICAL SUMMARY 1982 THUNDER BAY 'A'

TABLE III

Most of the elevation changes occurring between June 9 and November 3, 1982 are insignificant. The three major changes that did apparently occur are decreases of 16 cm of piezometer 5C, 21 cm of piezometer 7C and a decrease of 21 cm of piezometer 13B. These changes are likely measurement errors. The 1983 elevation measurements should confirm this conclusion.

2. Groundwater Levels

The piezometer water level data acquired in 1982 (Table II) show that groundwater levels in the fuel storage areas varied from a low of 0.24 m below the average shoreline level of 182.88 m (reference level) in piezometer 7C on November 9, 1982, to a high of 2.11 m in piezometer 2A on May 14, 1982. Other low values were observed in piezometers 7B, 8A, 8B and 8C and high values in piezometers 1A, 1B, 2B and 2C.

In general, the data show that high groundwater levels exist in the areas where piezometer nests 1, 2, 11, 15, 16 and 17 are located. Piezometers 1, 2 and 11 are inland and west of the lignite pile; piezometers 15, 16 and 17 are close to and around the lignite pile. The lowest groundwater levels exist in the area south and southeast of the lignite pile where piezometer nests 7 and 8 are located. These water levels are consistent with those observed in the previous years. Groundwater levels for piezometers 20A, 20B, 10A, 10B and 10C are not available. These piezometers were removed during the construction of the collecting pond.

The relationships between groundwater levels, lake levels and total precipitation, presented in Figure 2, show that in general the groundwater levels were relatively stable to the end of October and then decreased slightly during early November. The August and October levels given for piezometer 16A show a change in water levels contrary to that occurring in other piezometers. This could be due to a possibly erroneous water level measurement made on October 29. A similar contrary change in water levels occurring in piezometer 12A in 1981 is not repeated in 1982. In general, the changes in groundwater levels again appear to be seasonal and influenced by precipitation rather than by changes in lake water levels.

3. Groundwater Quality

The data on the chemical characteristics of the groundwaters sampled in 1982 are summarized in Appendix A. The major ion chemistry of the waters, illustrated by Piper diagrams and summarized by ion balances, is shown in Appendix B. The main characteristics on the groundwaters from locations around the lignite and the bituminous coal piles are discussed below.

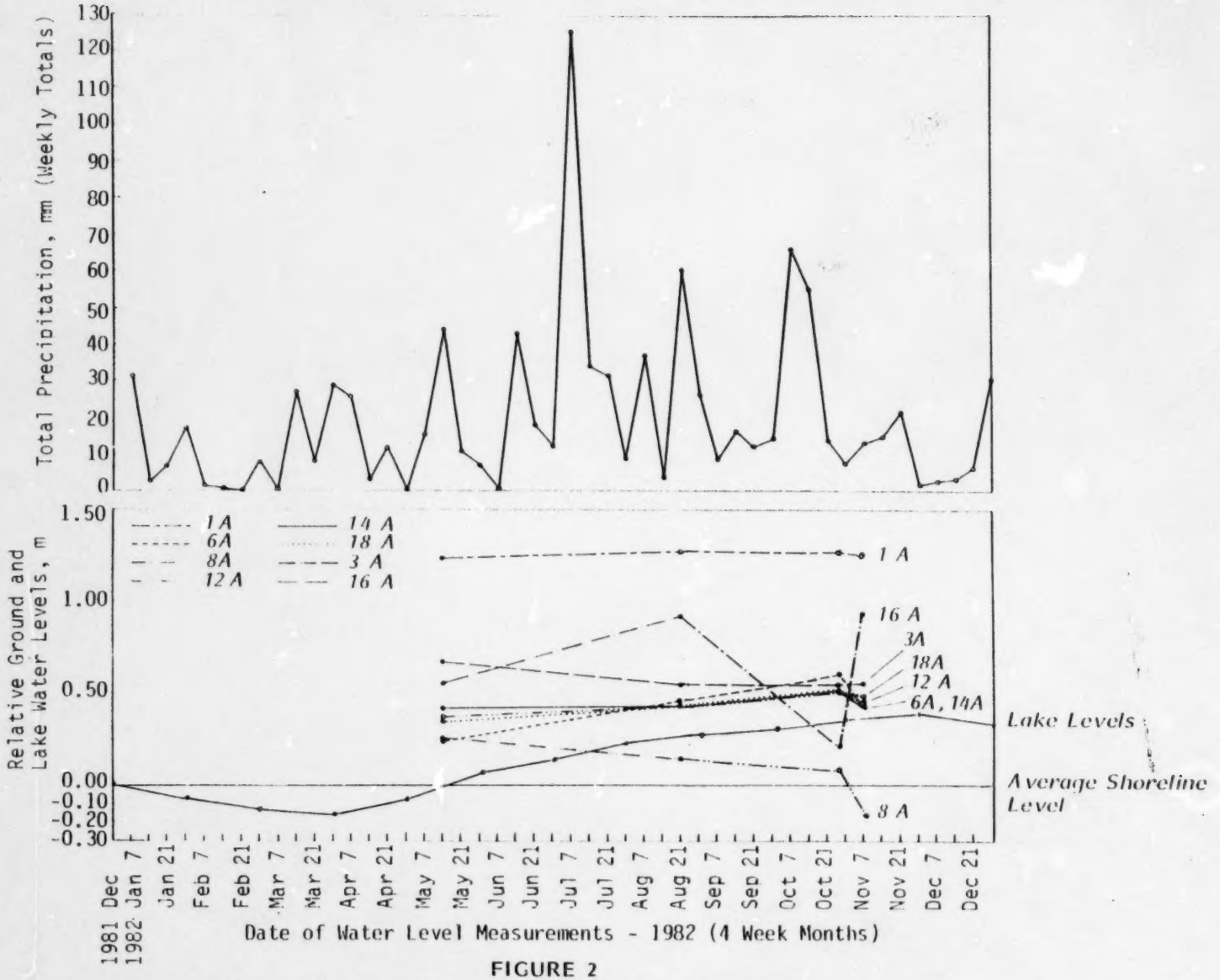


FIGURE 2

FUEL STORAGE AREA GROUND AND LAKE WATER LEVELS (m)* AND TOTAL PRECIPITATION, (mm) 1982 *RELATIVE TO AVERAGE LAKE SHORELINE LEVEL OF 182.88 m)

(a) pH

A summary of the 1982 pH levels in the groundwaters from the fuel storage areas is shown in Table IV .

During 1982 the pH levels of the groundwaters tested at Research ranged from a low of about 1.5 in piezometers 19A and 19B, (located outside the drainage ditch) on August 25 to a high of 8.5 in piezometer 3A on May 18, 1982. In general, waters of low pH levels (<6) were present in piezometers 12C, 13B, 13C, 14A, 14B, 14C, 18A, 18B, 19A and 19B. All of these piezometers are located on the east and south sides of the bituminous coal pile. Waters of neutral or alkaline pH values (>6) were present in the remaining piezometers, all located west of the bituminous coal pile and north and west of the lignite pile.

Comparison of the 1982 groundwater pH levels with pH levels present during the period between 1979 and 1981 shows essentially the same pattern, that is, low (acidic) pH levels in the waters around the bituminous coal pile and pH levels in the neutral or alkaline ranges in waters around the lignite pile. In general the 1982 pH levels in the groundwaters around the bituminous coal pile were slightly lower (more acidic), and very much lower for piezometers 19A and 19B, than they were during the previous years.

The low pH (4.7) of the groundwater in piezometer 20B on the south side of the lignite pile and sampled on July 4, 1980, was not confirmed by the 1981 data, which showed almost neutral pH. As this piezometer nest was destroyed, due to the construction of the collecting lagoon, pH values for 1982 for the groundwaters from this area were not obtained for further monitoring.

It is observed that pH levels determined at TBTGS on fresh, unfiltered samples (see Table IV) are all essentially between 6 and 7. The lowest pH level measured on a fresh sample was 5.0 from piezometer 13C (May 18, 1982) on the southeast corner of the bituminous coal pile. The highest pH level measured on a fresh sample was 7.4 from piezometer 8B (November 18, 1982) on the east side, mid-way between the two coal piles and close to the shore.

The differences in pH levels obtained at TBTGS on fresh unfiltered samples, and those obtained at Research on filtered and 'aged' samples, are probably partially due to measurement differences caused by the presence of soil particulates in the unfiltered samples. Another contributing factor for these differences may be the exposure of the samples to the atmosphere (oxygen) during filtration and storage. This would change the water's original reducing condition, which would allow the water's H^+ ions (acidity) to be tied up with soluble constituents, such as iron, producing higher pH levels, to an oxidizing condition which would cause

Table IV

Summary of pH Levels
of Groundwaters in the Fuel Storage Areas
Thunder Bay TGS Extension
1982

Piezometer	Dates Sampled					
	May 18 1982		August 25 1982		November 18 1982	
1A	8.1	(7.1)	6.9	(6.9)	7.3	(6.4)
3A	8.5	(6.7)	6.9	(6.4)	6.9	(6.6)
4A	7.1	(6.9)	6.5	(6.4)	7.3	(6.5)
5A	-	-	-	-	7.8	(7.1)
5C	7.7	(7.0)	7.0	(7.1)	-	-
6B	8.0	(7.0)	7.1	(7.1)	7.8	(6.5)
6C	8.2	(7.4)	6.8	(6.9)	7.3	(6.8)
7B	-	-	7.2	(6.8)	7.3	(7.1)
8B	8.0	(7.0)	6.8	(6.8)	7.2	(7.4)
12C	4.1	(6.5)	4.8	(6.2)	3.1	(6.2)
13B	3.0	(6.1)	5.5	(6.4)	4.3	(6.2)
13C	2.8	(5.0)	5.6	(6.4)	4.8	(6.2)
14A	4.2	(7.1)	5.4	(5.9)	4.6	(6.2)
14B	2.9	(7.2)	5.6	(6.1)	5.5	(6.4)
14C	6.1	(7.1)	6.1	(6.4)	6.1	(6.5)
15A	7.5	(6.9)	6.9	(7.0)	6.9	(6.8)
15B	7.5	(7.2)	6.8	(6.8)	6.9	(6.8)
16A	6.9	(6.9)	6.9	(6.6)	7.0	(6.9)
16B	7.5	(6.8)	6.7	(6.3)	6.7	(6.8)
17A	7.0	(6.8)	6.5	(6.4)	6.6	(6.6)
17B	-	-	6.8	(6.6)	6.9	(6.6)
18A	6.5	(6.6)	5.8	(6.6)	5.0	(6.4)
18B	2.9	(6.5)	6.1	(6.7)	6.2	(6.4)
19A	3.0	(6.4)	1.5	(6.1)	-	(6.3)
19B	-	(6.0)	1.4	(6.1)	3.5	(6.3)
20A	destroyed		destroyed		destroyed	
20B	destroyed		destroyed		destroyed	

() Field results on fresh unfiltered samples.

precipitation of the initially dissolved constituents, releasing H^+ ions, and decreasing the water's pH level. These pH changes will also result in the observed differences between the field and laboratory values for acidity, alkalinity and conductivity. Because of these field and laboratory differences in water characteristics a distinction may, therefore, have to be made in the water's assessment between the groundwater's quality (pH, acidity, alkalinity and conductivity) while in the ground and while out of the ground.

The remaining part of the discussion will be confined to the analytic data obtained on samples analyzed at Research.

(b) Alkalinity and Acidity

A summary of the 1982 alkalinity (HCO_3) and acidity levels in the groundwaters from the fuel storage areas as determined at Research is shown in Table V.

The 1982 data (Research) show that alkalinity levels ranged upwards from virtually zero in piezometers 12C, 13B, 13C, 14A, 14B, 18B and 19A. Other low alkalinity (<100 mg/L) values were measured in waters from piezometers 8B, 14C and 18A. Waters from most of these locations also had high acidities (measured to pH 4.5) and low (<6) pH levels. Waters from the remaining piezometers sampled had high (>100 mg/L) alkalinity values, no acidity and neutral or alkaline pH values.

As was the case with the data acquired during the previous studies, the 1982 data shows that waters of lowest alkalinities, highest acidities and low pH values are present in wells around the bituminous coal pile and waters of highest alkalinities, no acidity and high pH levels were present in wells around the lignite coal pile. All these observations are consistent with the known fact that the bituminous coal pile drainage is acidic and the hypothesis that the lignite coal pile drainage is neutral to alkaline.

Table V

Summary of Groundwater Alkalinity and Acidity
Fuel Storage Areas
Thunder Bay TGS Extension
1982
(in mg/L as $CaCO_3$)

Piezometer	Date Sampled					
	May 18 1982		August 25 1982		November 18 1982	
	Alk	Tot Acidity 4.5	Alk	Tot Acidity 4.5	Alk	Tot Acidity 4.5
1A	320		330		330	
3A	280		530		500	
4A	470		440		420	
5A	-				280	
5C	740		810			
6B	420		500		480	
6C	350		950		760	
7B	-		400		410	
8B	390		76		87	
12C		5	5			140
13B		100	19			8
13C		330	24			
14A		6	34			
14B		100	22		9	
14C	9		53		41	
15A	1100		850		720	
15B	740		920		860	
16A	500		810		750	
16B	680		730		750	
17A	820		570		450	
17B	-		1000		860	
18A	61		26		7	
18B		120	56		49	
19A		180		2900		
19B				2900		81
20A	-					
20B	-					

(c) Conductivity

A summary of conductivity levels is given in Table VI.

Groundwaters of low conductivities (100 mS/m), indicating low ionic content, and commonly associated with the characteristics of natural surface waters, were present in piezometers 1A, 3A, 4A, 8B and 16A. Piezometers 1A and 3A are located west of the lignite pile. The remaining piezometers are close to and on the north and east side of the lignite pile. Groundwaters of high conductivities (>300 mS/m) were present in piezometers 13C, 14A, 19A and 19B all on the east and south sides of the bituminous coal pile. These conductivity levels show that the groundwaters least affected by coal pile leachates are in areas west of the coal piles and to a lesser degree around the lignite pile and those most affected are around the bituminous pile.

(d) Iron

Iron concentrations are summarized in Table VII.

Iron concentrations in the groundwaters sampled in 1982 ranged from a low of <1.05 mg/L in several samples to levels above 100 mg/L in piezometers 13C, 14A, 14B, 15A, 16B, 17A, 18A, 18B, 19A and 19B. While most of these piezometers are located around the bituminous coal pile, where high iron levels are expected, piezometers 15A and 16B are located north of the lignite pile where high iron levels were not expected. Higher than expected iron concentrations were also observed in waters from piezometers 3A, 4A, 5C, 6B and 6C, all in the vicinity of the lignite coal pile and along the route of the drainage ditch. The high iron concentrations around the lignite pile could be due to lignite leachate but may also possibly be due to actual migration or accidental flow of bituminous coal leachate.

(e) Sulphate

A summary of the 1982 sulphate concentrations in the groundwaters is shown in Table VIII.

During 1982, sulphate concentrations in the groundwaters sampled varied from a low of <1 mg/L in piezometer 6B to a high of 3900 mg/L in piezometer 14A. Low sulphate levels (<200 mg/L) were present in waters from piezometers surrounding the lignite pile. High sulphate levels (>400 mg/L) were present in waters from piezometers on the east and south sides of the bituminous coal pile. This pattern of sulphate levels observed in 1982 is similar to that observed each year since 1979.

It is observed that sulphate concentrations in groundwaters from some piezometers around the lignite coal pile were higher in 1982 than during the previous years. Water from piezometers 5C, 6C, 15B, 16B and 17A, which had relatively low SO_4 concentrations (highs of between 10 and 150 mg/L) during the past three years,

TABLE VI

SUMMARY OF GROUNDWATER CONDUCTIVITY
FUEL STORAGE AREA
THUNDER BAY TGS EXTENSION
1982
(in mS/m at 25°C)

Location	Sampling Dates		
	82 05 18	82 08 25	82 11 18
01A	79	86	84
03A	56	96	95
04A	94	102	88
05A	--	--	310
05C	160	182	--
06B	150	168	161
06C	130	209	192
07B	--	92	95
08B	88	47	42
12C	175	200	255
13B	170	215	300
13C	300	185	270
14A	470	473	450
14B	202	262	235
14C	134	199	170
15A	180	160	156
15B	145	178	165
16A	95	174	160
16B	158	123	132
17A	155	230	246
17B	--	184	175
18A	126	182	232
18B	180	125	160
19A	345	2000	--
19B	--	2030	321

TABLE VII

SUMMARY OF GROUNDWATER IRON CONTENT
FUEL STORAGE AREA
THUNDER BAY TGS EXTENSION
1982
(in mg/L Fe)

Location	Sampling Dates		
	82 05 18	82 08 25	82 11 18
01A	0.14	0.91	0.20
03A	16	60	41
04A	61	96	0.06
05A	--	--	0.21
05C	1.86	70	--
06B	<0.05	17	22
06C	3.56	88	8.3
07B	--	5.5	0.11
08B	0.05	7.6	3.4
12C	0.15	46	22
13B	32	238	353
13C	133	191	339
14A	640	672	590
14B	15	170	108
14C	<0.05	44	3.2
15A	20	110	53
15B	0.08	74	29
16A	58	86	25
16B	16	140	99
17A	90	189	91
17B	--	139	90
18A	<0.05	202	233
18B	13	26	11.5
19A	260	--	--
19B	--	--	161

Table VIII

Summary of
Groundwater Sulphate Concentrations
Fuel Storage Areas
Thunder Bay TGS Extension
1982

(SO_4 in mg/L)

Piezometer	Dates Sampled		
	May 18 1982	August 25 1982	November 18 1982
1A	8.9	2.0	2.4
3A	16	19	3.0
4A	140	170	92
5A			4.0
5C	100	22	
6B	21	<0.2	0.8
6C	10	200	190
7B		1.5	0.9
8B	66	85	94
12C	810	990	1500
13B	740	1300	2200
13C	430	1100	2200
14A	3600	3900	3500
14B	1100	2100	1500
14C	770	1200	940
15A	6.3	0.3	0.9
15B	4.5	250	220
16A	1.8	1.8	35
16B	100	14	8.6
17A	1.0	1500	1100
17B		7.1	77
18A	680	1300	1700
18B	890	820	920
19A	2400	3500	
19B		1500	2300
20A	Destroyed	Destroyed	Destroyed
20B	Destroyed	Destroyed	Destroyed

had SO_4 concentrations ranging from 100 to 1500 mg/L. All of these piezometers are located on the north and east sides of the lignite pile, piezometers 5C, 6C, and 16B outside the drainage ditch, and piezometers 16B and 17A inside. This change, together with that observed for the high iron concentrations in piezometers 15A, 16B, 17A and 17B in 1982 suggests possible change in lignite leachate characteristics or of possible accidental contamination by SO_4 rich aqueous wastes from other areas on the site. These changes in SO_4 and Fe concentrations are not accompanied by significant changes in pH and alkalinities.

(f) Trace Metals

A cursory examination of the 1982 and of the previously obtained data on trace metals concentrations in the groundwaters around the fuel storage areas does not show any apparent significant changes or trends. However, it is planned to examine these data in detail, possibly in 1984, when all the data will be stored in the computer and be accessible for quick and easy comparison and statistical analysis.

(g) Piper Plots

As was the case with the previous years' data, the 1982 analytic data on the groundwater quality in the fuel storage areas show the presence of two distinct water types, as illustrated in a typical Piper plot, shown in Figure 3, selected from those given in Appendix B. One type represents groundwater in which alkaline earths and weak acid anions (HCO_3 and CO_3), resembling natural groundwater, predominate. This water type represents waters mainly from piezometers surrounding the lignite pile and those some distance west of the two piles. The other type represents groundwater in which alkaline earths and strong acid anions (SO_4 and Cl), predominate. This type represents waters, mainly from piezometers east and south of the bituminous coal pile, containing typical acidic bituminous coal leachates.

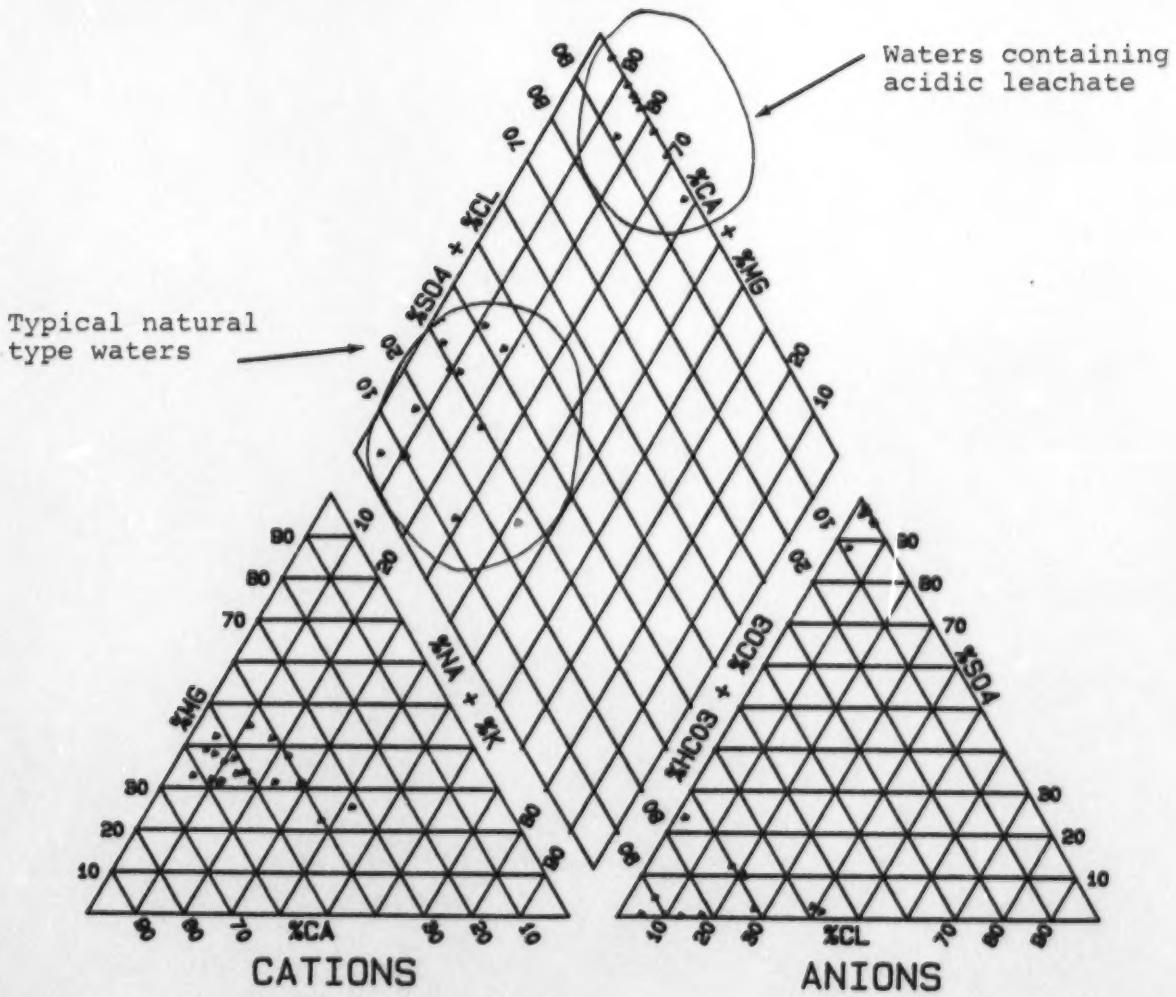
(h) Drainage Ditches

The sulphate concentrations present in waters from piezometers on opposite sides of the drainage ditches show little if any difference. For example waters from piezometer nest 14, on the bituminous coal pile side of the ditch, had SO_4 concentrations in 1982 of between 770 and 3900 mg/L, and waters from piezometer nest 19, on the other side of the ditch, had SO_4 concentrations between 1500 and 3500 mg/L.

There seems to be a significant difference in SO_4 concentrations in waters from piezometer nests 6 and 17 east of the lignite pile. Waters from piezometers 6 on the lake side of the ditch have lower SO_4 concentrations (<200 mg/L) than the waters from pezometers 17 (1500 mg/L) on the lignite pile side. This would

FIGURE 3

MAJOR ION CHEMISTRY
TBTGS FUEL
MAY 18 1982
TYPE - WATER
FUEL STORAGE AREA GROUNDWATER QUALITY- TBTGS



83-442

suggest some beneficial influence by the ditch on SO_4 contamination. However, because piezometers 6B and 6C are very close to the lake the lower SO_4 levels in these piezometers could be due to dilution of any high sulphate leachates with the lake water. The situation with piezometers 15 and 16 is reversed, waters from the lake side of the ditch have higher SO_4 levels (up to 250 mg/L) than the waters from the lignite side (<100 mg/L). The pH levels in groundwaters from piezometers on opposite sides of the drainage ditches show little if any difference except for piezometer 14 and 19. Waters from piezometer 19B on the outside of the ditch, had pH levels between 1.4 and 3.5 Waters from piezometer 14, on the coal pile side of the ditch, had one pH of 2.9 and the remaining eight readings between 4.2 and 6.1. This result is contrary to the expected effect of the ditch. However, there might have existed some unusual physical conditions or occurrences in the area to account for the lower pH levels in waters outside the ditch.

CONCLUSIONS AND RECOMMENDATIONS

Because changes in piezometer levels appear to have stabilized, one annual level survey is recommended for future studies.

Generally the 1982 data on the groundwater quality are similar to those acquired during the past years. The pattern of low pH levels and high sulphate and high iron concentrations around the bituminous coal pile observed in the past are evident in the 1982 data. However, increases in iron and sulphate concentrations have occurred in 1982 in some piezometers around the lignite pile suggesting change in lignite leachate characteristics or of possible accidental contamination by liquid wastes from the bituminous coal pile area.

Because pH and sulphate levels in waters on opposite sides of the drainage ditches are inconsistent, no conclusion can be reached on the effect of the drainage ditches on water quality. It is possible that the 1983 data might be more indicative or that a longer term of monitoring will be required to show the true effect of the drainage ditches on water quality.

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APPENDIX A

POST-OPERATIONAL FUEL STORAGE AREA
GROUNDWATER QUALITY STUDIES - 1982
THUNDER BAY TGS EXTENSION

GROUNDWATER CHARACTERISTICS

All values are in mg/L except pH and conductivity
- pH in pH units
- conductivity in mS/m

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 01A

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	<5.0	--
ALKHCO3	320.	--	330.	--	330.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	300.	--	340.	--	320.
AS	<.0010	--	--	--	--	--
B	<.50	--	<1.0	--	1.5	--
BA	<.050	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	76.	--	83.	--	73.	--
CD	<.00010	--	--	--	--	--
CL	90.	--	95.	--	100.	--
CO	<.00010	--	--	--	--	--
COND	79.	85.	86.	94.	84.	80.
CR	<.0010	--	--	--	--	--
CU	.0080	--	--	--	--	--
F	.20	--	--	--	--	--
FE	.14	--	.91	--	.20	--
HG	<.00020	--	--	--	--	--
K	1.9	--	2.2	--	2.7	--
MG	32.	--	36.	--	32.	--
MN	7.2	--	8.1	--	7.5	--
MO	<.50	--	--	--	--	--
NA	44.	--	54.	--	49.	--
NI	.0080	--	--	--	--	--
NO3	.050	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	8.1	7.1	6.9	6.9	7.3	6.4
PO4	.030	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	17.	--	--	--	--	--
SO4	8.9	--	2.0	--	2.4	--
SR	<.20	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

* TBTGS field data on fresh samples taken on the day before that shown.

000025

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 03A

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	44.	--	--	--	<5.0	--
ALKHCO3	260.	--	530.	--	500.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	250.	--	680.	--	490.
AS	<.0010	--	--	--	--	--
B	<.50	--	<1.0	--	1.6	--
BA	.10	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	71.	--	120.	--	97.	--
CD	<.00010	--	--	--	--	--
CL	15.	--	35.	--	44.	--
CO	.0090	--	--	--	--	--
COND	56.	100.	96.	130.	95.	110.
CR	.0050	--	--	--	--	--
CU	.035	--	--	--	--	--
F	.20	--	--	--	--	--
FE	16.	--	60.	--	41.	--
HG	<.00020	--	--	--	--	--
K	1.5	--	2.7	--	2.0	--
MG	29.	--	56.	--	47.	--
MN	1.5	--	1.7	--	1.3	--
MO	<.50	--	--	--	--	--
NA	15.	--	36.	--	30.	--
NI	.010	--	--	--	--	--
NO3	.080	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	8.5	6.7	6.9	6.4	6.9	6.6
PO4	<.030	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	21.	--	--	--	--	--
SO4	16.	--	19.	--	3.0	--
SR	.20	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000026

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 04A

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	<5.0	--
ALKHCO3	470.	--	440.	--	420.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	400.	--	630.	--	410.
AS	<.0010	--	--	--	--	--
B	<.50	--	<1.0	--	<.50	--
BA	.12	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	70.	--	120.	--	82.	--
CD	<.00010	--	--	--	--	--
CL	11.	--	16.	--	13.	--
CO	.0020	--	--	--	--	--
COND	94.	150.	100.	140.	88.	88.
CR	.0030	--	--	--	--	--
CU	.0020	--	--	--	--	--
F	.20	--	--	--	--	--
FE	61.	--	96.	--	.060	--
HG	<.00020	--	--	--	--	--
K	6.6	--	7.2	--	7.7	--
MG	34.	--	54.	--	42.	--
MN	.87	--	1.4	--	.98	--
MO	<.50	--	--	--	--	--
NA	100.	--	41.	--	34.	--
NI	<.0050	--	--	--	--	--
NO3	.060	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	7.1	6.9	6.5	6.4	7.3	6.5
PO4	.040	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	21.	--	--	--	--	--
SO4	140.	--	170.	--	92.	--
SR	.30	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 05A

TEST	SAMPLING DATE 820518	820519*	820825	820826*	821118	821119*
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	--	--	--	--	--	--
AL	--	--	--	--	--	--
ALKCO3	--	--	--	--	<5.0	--
ALKHCO3	--	--	--	--	280.	--
ALKOH	--	--	--	--	<5.0	--
ALKTOT	--	--	--	--	--	--
AS	--	--	--	--	--	--
B	--	--	--	--	1.4	--
BA	--	--	--	--	--	--
BE	--	--	--	--	--	--
CA	--	--	--	--	260.	--
CD	--	--	--	--	--	--
CL	--	--	--	--	900.	--
CO	--	--	--	--	--	--
COND	--	--	--	--	310.	--
CR	--	--	--	--	--	--
CU	--	--	--	--	--	--
F	--	--	--	--	--	--
FE	--	--	--	--	.21	--
HG	--	--	--	--	--	--
K	--	--	--	--	4.4	--
MG	--	--	--	--	110.	--
MN	--	--	--	--	3.0	--
MO	--	--	--	--	--	--
NA	--	--	--	--	160.	--
NI	--	--	--	--	--	--
NO3	--	--	--	--	--	--
PB	--	--	--	--	--	--
PH	--	--	--	--	7.8	--
PO4	--	--	--	--	<.030	--
SE	--	--	--	--	--	--
SI	--	--	--	--	--	--
SO4	--	--	--	--	4.0	--
SR	--	--	--	--	--	--
TH	--	--	--	--	--	--
TI	--	--	--	--	--	--
V	--	--	--	--	--	--
ZN	--	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000028

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 05C

TEST	SAMPLING DATE 820518	820519*	820825	820826*	821118	821119*
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	--	--
ALKHCO3	740.	--	810.	--	--	--
ALKOH	<5.0	--	--	--	--	--
ALKTOT	--	630.	--	910.	--	260.
AS	<.0010	--	--	--	--	--
B	<.50	--	<1.0	--	--	--
BA	.22	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	220.	--	220.	--	--	--
CD	<.00010	--	--	--	--	--
CL	170.	--	170.	--	--	--
CO	.0010	--	--	--	--	--
COND	160.	230.	180.	230.	--	340.
CR	.0030	--	--	--	--	--
CU	.0030	--	--	--	--	--
F	.20	--	--	--	--	--
FE	1.9	--	70.	--	--	--
HG	<.00020	--	--	--	--	--
K	2.9	--	3.5	--	--	--
MG	76.	--	83.	--	--	--
MN	2.4	--	2.7	--	--	--
MO	<.50	--	--	--	--	--
NA	54.	--	54.	--	--	--
NI	<.0050	--	--	--	--	--
NO3	.020	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	7.7	7.0	7.0	7.1	--	7.1
PO4	<.030	--	<.030	--	--	--
SE	<.0010	--	--	--	--	--
SI	18.	--	--	--	--	--
SO4	100.	--	22.	--	--	--
SR	.30	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 06B

TEST	820518	820519*	820825	820826*	821118	821119*
	SAMPLING DATE					
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	29.	--	--	--	<5.0	--
ALKHCO3	420.	--	500.	--	480.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	490.	--	520.	--	460.
AS	<.0010	--	--	--	--	--
B	<.50	--	<1.0	--	<.50	--
BA	.19	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	180.	--	190.	--	180.	--
CD	<.00010	--	--	--	--	--
CL	220.	--	230.	--	290.	--
CO	.00080	--	--	--	--	--
COND	150.	170.	170.	180.	160.	160.
CR	.0030	--	--	--	--	--
CU	.0080	--	--	--	--	--
F	.20	--	--	--	--	--
FE	<.050	--	17.	--	22.	--
HG	.00030	--	--	--	--	--
K	3.0	--	3.3	--	3.5	--
MG	59.	--	68.	--	58.	--
MN	1.9	--	2.4	--	2.2	--
MO	<.50	--	--	--	--	--
NA	41.	--	50.	--	44.	--
NI	<.0050	--	--	--	--	--
NO3	1.1	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	8.0	7.0	7.1	7.1	7.8	6.5
PO4	.040	--	<.030	--	.045	--
SE	<.0010	--	--	--	--	--
SI	25.	--	--	--	--	--
SO4	21.	--	<.20	--	.82	--
SR	.20	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000030

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 06C

TEST	SAMPLING DATE 820518	820519*	820825	820826*	821118	821119*
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	32.	--	--	--	<5.0	--
ALKHCO3	350.	--	950.	--	760.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	340.	--	1000.	--	730.
AS	<.0010	--	--	--	--	--
B	<.50	--	<1.0	--	1.7	--
BA	.16	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	130.	--	240.	--	250.	--
CD	<.00010	--	--	--	--	--
CL	200.	--	150.	--	180.	--
CO	.00090	--	--	--	--	--
COND	130.	140.	210.	270.	190.	190.
CR	.0030	--	--	--	--	--
CU	.0040	--	--	--	--	--
F	.20	--	--	--	--	--
FE	3.6	--	88.	--	8.3	--
HG	<.00020	--	--	--	--	--
K	2.7	--	2.6	--	3.4	--
MG	51.	--	100.	--	87.	--
MN	2.1	--	2.9	--	2.4	--
MO	<.50	--	--	--	--	--
NA	55.	--	54.	--	47.	--
NI	<.0050	--	--	--	--	--
NO3	25.	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	8.2	7.4	6.8	6.9	7.3	6.8
PO4	.26	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	24.	--	--	--	--	--
SO4	10.	--	200.	--	190.	--
SR	<.20	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 07B

TEST	SAMPLING DATE 820518	820519*	820825	820826*	821118	821119*
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	--	--	--	--	--	--
AL	--	--	--	--	--	--
ALKCO3	--	--	--	--	<5.0	--
ALKHCO3	--	--	400.	--	410.	--
ALKOH	--	--	--	--	<5.0	--
ALKTOT	--	--	--	410.	--	390.
AS	--	--	--	--	--	--
B	--	--	<1.0	--	1.6	--
BA	--	--	--	--	--	--
BE	--	--	--	--	--	--
CA	--	--	120.	--	110.	--
CD	--	--	--	--	--	--
CL	--	--	76.	--	66.	--
CO	--	--	--	--	--	--
COND	--	--	92.	100.	95.	95.
CR	--	--	--	--	--	--
CU	--	--	--	--	--	--
F	--	--	--	--	--	--
FE	--	--	5.5	--	.11	--
HG	--	--	--	--	--	--
K	--	--	1.7	--	2.0	--
MG	--	--	42.	--	36.	--
MN	--	--	1.6	--	1.5	--
MO	--	--	--	--	--	--
NA	--	--	27.	--	24.	--
NI	--	--	--	--	--	--
NO3	--	--	--	--	--	--
PB	--	--	--	--	--	--
PH	--	--	7.2	6.8	7.3	7.1
PO4	--	--	<.030	--	<.030	--
SE	--	--	--	--	--	--
SI	--	--	--	--	--	--
SO4	--	--	1.5	--	.89	--
SR	--	--	--	--	--	--
TH	--	--	--	--	--	--
TI	--	--	--	--	--	--
V	--	--	--	--	--	--
ZN	--	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 08B

TEST	820518	820519*	820825	820826*	821118	821119*
	SAMPLING DATE					
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	<5.0	--
ALKHCO3	390.	--	76.	--	87.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	310.	--	80.	--	90.
AS	<.0010	--	--	--	--	--
B	<.50	--	1.3	--	2.6	--
BA	.11	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	120.	--	38.	--	35.	--
CD	<.00010	--	--	--	--	--
CL	71.	--	37.	--	20.	--
CO	.00080	--	--	--	--	--
COND	88.	100.	47.	62.	42.	42.
CR	.010	--	--	--	--	--
CU	.0020	--	--	--	--	--
F	.20	--	--	--	--	--
FE	.050	--	7.6	--	3.4	--
HG	<.00020	--	--	--	--	--
K	1.5	--	2.8	--	3.1	--
MG	39.	--	6.0	--	7.0	--
MN	1.7	--	.67	--	1.8	--
MO	<.50	--	--	--	--	--
NA	22.	--	50.	--	37.	--
NI	<.0050	--	--	--	--	--
NO3	.10	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	8.0	7.0	6.8	6.8	7.2	7.4
PO4	<.030	--	<.030	--	.090	--
SE	<.0010	--	--	--	--	--
SI	28.	--	--	--	--	--
SO4	66.	--	85.	--	94.	--
SR	.20	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 12C

TEST	820518	820519*	820825	820826*	821118	821119*
	SAMPLING DATE					
ACID4.5	5.0	--	--	--	140.	--
ACID8.3	23.	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	--	--	--	--	--	--
ALKHCO3	--	--	5.0	--	--	--
ALKOH	<5.0	--	--	--	--	--
ALKTOT	--	30.	--	10.	--	--
AS	<.0010	--	--	--	--	--
B	2.0	--	<1.0	--	2.4	--
BA	<.050	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	290.	--	240.	--	350.	--
CD	.00030	--	--	--	--	--
CL	34.	--	120.	--	40.	--
CO	.0020	--	--	--	--	--
COND	170.	220.	200.	230.	250.	270.
CR	<.0010	--	--	--	--	--
CU	.020	--	--	--	--	--
F	.20	--	--	--	--	--
FE	.15	--	46.	--	22.	--
HG	<.00020	--	--	--	--	--
K	2.4	--	10.	--	7.9	--
MG	94.	--	62.	--	100.	--
MN	4.4	--	42.	--	66.	--
MO	<.50	--	--	--	--	--
NA	29.	--	92.	--	49.	--
NI	.014	--	--	--	--	--
NO3	<.010	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	4.1	6.5	4.8	6.2	3.1	6.2
PO4	<.030	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	25.	--	--	--	--	--
SO4	810.	--	990.	--	1500.	--
SR	.50	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	.16	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 13B

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	100.	91.	--	--	8.0	--
ACID8.3	160.	--	--	--	--	--
AG	.00030	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	--	--	--	--	<5.0	--
ALKHCO3	--	--	19.	--	<5.0	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	--	--	80.	--	--
AS	<.0010	--	--	--	--	--
B	1.7	--	1.0	--	2.5	--
BA	<.050	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	150.	--	200.	--	330.	--
CD	.00030	--	--	--	--	--
CL	19.	--	20.	--	25.	--
CO	.090	--	--	--	--	--
COND	170.	160.	210.	260.	300.	350.
CR	.0030	--	--	--	--	--
CU	.11	--	--	--	--	--
F	.20	--	--	--	--	--
FE	32.	--	240.	--	350.	--
HG	<.00020	--	--	--	--	--
K	5.3	--	6.7	--	8.8	--
MG	60.	--	92.	--	130.	--
MN	30.	--	46.	--	64.	--
MO	<.50	--	--	--	--	--
NA	50.	--	57.	--	70.	--
NI	.25	--	--	--	--	--
NO3	.020	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	3.0	6.1	5.5	6.4	4.3	6.2
PO4	.060	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	25.	--	--	--	--	--
SO4	740.	--	1300.	--	2200.	--
SR	.30	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	1.3	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000035

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 13C

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	330.	330.	--	--	--	--
ACID8.3	640.	--	--	--	--	--
AG	.00070	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	--	--	--	--	<5.0	--
ALKHCO3	--	--	24.	--	<5.0	--
ALKOH	--	--	--	--	<5.0	--
ALKTOT	--	--	--	70.	--	20.
AS	<.0010	--	--	--	--	--
B	2.3	--	<1.0	--	2.7	--
BA	<.050	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	300.	--	190.	--	260.	--
CD	.0025	--	--	--	--	--
CL	21.	--	19.	--	35.	--
CO	.30	--	--	--	--	--
COND	300.	330.	180.	230.	270.	310.
CR	.0080	--	--	--	--	--
CU	.11	--	--	--	--	--
F	1.5	--	--	--	--	--
FE	130.	--	190.	--	340.	--
HG	<.00020	--	--	--	--	--
K	9.2	--	5.9	--	8.5	--
MG	110.	--	80.	--	110.	--
MN	40.	--	38.	--	50.	--
MO	<.50	--	--	--	--	--
NA	89.	--	56.	--	72.	--
NI	.50	--	--	--	--	--
NO3	.040	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	2.8	5.0	5.6	6.4	4.8	6.2
PO4	<.030	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	29.	--	--	--	--	--
SO4	430.	--	1100.	--	2200.	--
SR	.40	--	--	--	--	--
TH	.00030	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	1.0	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

960036

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 14A

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	6.0	--	--	--	--	--
ACID8.3	1200.	--	--	--	--	--
AG	.0013	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	--	--	--	--	<5.0	--
ALKHCO3	--	--	34.	--	<5.0	--
ALKOH	--	--	--	--	<5.0	--
ALKTOT	--	50.	--	160.	--	40.
AS	<.0010	--	--	--	--	--
B	1.6	--	<1.0	--	2.0	--
BA	<.050	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	450.	--	270.	--	400.	--
CD	.00010	--	--	--	--	--
CL	60.	--	54.	--	58.	--
CO	.020	--	--	--	--	--
COND	470.	540.	470.	530.	450.	490.
CR	.0050	--	--	--	--	--
CU	.016	--	--	--	--	--
F	<.20	--	--	--	--	--
FE	640.	--	670.	--	590.	--
HG	.00030	--	--	--	--	--
K	3.9	--	4.5	--	5.2	--
MG	280.	--	250.	--	250.	--
MN	100.	--	100.	--	94.	--
MO	<.50	--	--	--	--	--
NA	220.	--	210.	--	190.	--
NI	.055	--	--	--	--	--
NO3	.030	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	4.2	7.1	5.4	5.9	4.6	6.2
PO4	<.030	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	29.	--	--	--	--	--
SO4	3600.	--	3900.	--	3500.	--
SR	.60	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000037

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 14B

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	100.	91.	--	--	--	--
ACID8.3	130.	--	--	--	--	--
AG	.00050	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	--	--	--	--	<5.0	--
ALKHCO3	--	--	22.	--	9.0	--
ALKOH	--	--	--	--	<5.0	--
ALKTOT	--	--	--	70.	--	20.
AS	<.0010	--	--	--	--	--
B	1.7	--	<1.0	--	2.1	--
BA	<.050	--	--	--	--	--
BE	<.0020	--	--	--	--	--
CA	150.	--	240.	--	200.	--
CD	<.00020	--	--	--	--	--
CL	17.	--	23.	--	16.	--
CO	.050	--	--	--	--	--
COND	200.	230.	260.	320.	230.	250.
CR	.010	--	--	--	--	--
CU	.0070	--	--	--	--	--
F	<.20	--	--	--	--	--
FE	15.	--	170.	--	110.	--
HG	<.00020	--	--	--	--	--
K	3.4	--	5.8	--	5.6	--
MG	73.	--	100.	--	89.	--
MN	30.	--	48.	--	40.	--
MO	<.50	--	--	--	--	--
NA	130.	--	180.	--	160.	--
NI	.048	--	--	--	--	--
NO3	.080	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	2.9	7.2	5.6	6.1	5.5	6.4
PO4	<.030	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	27.	--	--	--	--	--
SO4	1100.	--	2100.	--	1500.	--
SR	.30	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	.050	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 14C

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	<5.0	--
ALKHCO3	9.0	--	53.	--	41.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	--	--	100.	--	50.
AS	<.0010	--	--	--	--	--
B	2.1	--	<1.0	--	2.3	--
BA	<.050	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	120.	--	190.	--	150.	--
CD	.0016	--	--	--	--	--
CL	14.	--	16.	--	20.	--
CO	.010	--	--	--	--	--
COND	130.	180.	200.	240.	170.	200.
CR	.0010	--	--	--	--	--
CU	.0030	--	--	--	--	--
F	<.20	--	--	--	--	--
FE	<.050	--	44.	--	3.2	--
HG	.0010	--	--	--	--	--
K	1.7	--	2.8	--	2.8	--
MG	42.	--	64.	--	50.	--
MN	13.	--	23.	--	18.	--
MO	<.50	--	--	--	--	--
NA	130.	--	180.	--	160.	--
NI	.011	--	--	--	--	--
NO3	.080	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	6.1	7.1	6.1	6.4	6.1	6.5
PO4	.030	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	19.	--	--	--	--	--
SO4	770.	--	1200.	--	940.	--
SR	.20	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000033

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 15A

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	<5.0	--
ALKHCO3	1100.	--	850.	--	720.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	900.	--	700.	--	730.
AS	<.0010	--	--	--	--	--
B	<.50	--	<1.0	--	1.5	--
BA	<.050	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	240.	--	200.	--	200.	--
CD	.00010	--	--	--	--	--
CL	42.	--	120.	--	150.	--
CO	.010	--	--	--	--	--
COND	180.	250.	160.	190.	160.	170.
CR	.0040	--	--	--	--	--
CU	.0060	--	--	--	--	--
F	<.20	--	--	--	--	--
FE	20.	--	110.	--	53.	--
HG	<.00020	--	--	--	--	--
K	10.	--	1.9	--	2.2	--
MG	120.	--	84.	--	80.	--
MN	17.	--	4.4	--	4.1	--
MO	<.50	--	--	--	--	--
NA	24.	--	33.	--	32.	--
NI	.026	--	--	--	--	--
NO3	.020	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	7.5	6.9	6.9	7.0	6.9	6.8
PO4	.11	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	17.	--	--	--	--	--
SO4	6.3	--	.30	--	.87	--
SR	.40	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000040

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 15B

TEST	820518	820519*	820825	820826*	821118	821119*
	SAMPLING DATE					
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	<5.0	--
ALKHCO3	740.	--	920.	--	860.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	750.	--	1000.	--	870.
AS	<.0010	--	--	--	--	--
B	<.50	--	<1.0	--	1.4	--
BA	.090	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	190.	--	220.	--	240.	--
CD	.00030	--	--	--	--	--
CL	110.	--	19.	--	20.	--
CO	.0040	--	--	--	--	--
COND	140.	210.	180.	230.	160.	200.
CR	.0030	--	--	--	--	--
CU	.0050	--	--	--	--	--
F	<.20	--	--	--	--	--
FE	.080	--	74.	--	29.	--
HG	<.00020	--	--	--	--	--
K	2.2	--	8.8	--	6.4	--
MG	80.	--	100.	--	98.	--
MN	3.6	--	19.	--	19.	--
MO	<.50	--	--	--	--	--
NA	29.	--	22.	--	14.	--
NI	.012	--	--	--	--	--
NO3	.020	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	7.5	7.2	6.8	6.8	6.9	6.8
PO4	<.030	--	.036	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	18.	--	--	--	--	--
SO4	4.5	--	250.	--	220.	--
SR	.30	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000041

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 16A

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	<5.0	--
ALKHCO3	500.	--	810.	--	750.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	540.	--	900.	--	750.
AS	<.0010	--	--	--	--	--
B	1.2	--	<1.0	--	1.5	--
BA	.10	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	84.	--	220.	--	220.	--
CD	.00040	--	--	--	--	--
CL	40.	--	170.	--	160.	--
CO	.0030	--	--	--	--	--
COND	95.	140.	170.	220.	160.	180.
CR	.0040	--	--	--	--	--
CU	.0040	--	--	--	--	--
F	<.20	--	--	--	--	--
FE	58.	--	86.	--	25.	--
HG	<.00020	--	--	--	--	--
K	5.2	--	2.2	--	2.9	--
MG	52.	--	91.	--	86.	--
MN	1.8	--	3.4	--	3.7	--
MO	.50	--	--	--	--	--
NA	22.	--	30.	--	23.	--
NI	<.0050	--	--	--	--	--
NO3	.020	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	6.9	6.9	6.9	6.6	7.0	6.9
PO4	<.030	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	21.	--	--	--	--	--
SO4	1.8	--	1.8	--	35.	--
SR	.20	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 16B

TEST	820518	820519*	820825	820826*	821118	821119*
		SAMPLING DATE				
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	<5.0	--
ALKHCO3	680.	--	730.	--	750.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	680.	--	880.	--	710.
AS	<.0010	--	--	--	--	--
B	<.50	--	<1.0	--	1.6	--
BA	.18	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	220.	--	110.	--	110.	--
CD	.00010	--	--	--	--	--
CL	150.	--	36.	--	44.	--
CO	.0020	--	--	--	--	--
COND	160.	210.	120.	170.	130.	160.
CR	.0020	--	--	--	--	--
CU	.0040	--	--	--	--	--
F	<.20	--	--	--	--	--
FE	16.	--	140.	--	99.	--
HG	<.00020	--	--	--	--	--
K	2.7	--	7.0	--	7.3	--
MG	92.	--	63.	--	64.	--
MN	3.3	--	1.8	--	2.1	--
MO	<.50	--	--	--	--	--
NA	22.	--	64.	--	86.	--
NI	.0050	--	--	--	--	--
NO3	.060	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	7.5	6.8	6.7	6.3	6.7	6.8
PO4	<.030	--	.060	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	21.	--	--	--	--	--
SO4	100.	--	14.	--	8.6	--
SR	.40	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	<.020	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 17A

TEST	820518	820519*	820825	820826*	821118	821119*
	SAMPLING DATE					
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	<.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	<5.0	--
ALKHCO3	820.	--	570.	--	450.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	930.	--	570.	--	570.
AS	<.0010	--	--	--	--	--
B	<.50	--	<1.0	--	1.5	--
BA	<.050	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	130.	--	310.	--	290.	--
CD	<.00010	--	--	--	--	--
CL	91.	--	43.	--	60.	--
CO	.0060	--	--	--	--	--
COND	150.	240.	230.	340.	250.	320.
CR	.0040	--	--	--	--	--
CU	.0020	--	--	--	--	--
F	<.20	--	--	--	--	--
FE	90.	--	190.	--	91.	--
HG	.0024	--	--	--	--	--
K	16.	--	7.5	--	9.2	--
MG	65.	--	120.	--	120.	--
MN	4.1	--	3.4	--	3.1	--
MO	<.50	--	--	--	--	--
NA	100.	--	190.	--	170.	--
NI	<.0050	--	--	--	--	--
NO3	.41	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	7.0	6.8	6.5	6.4	6.6	6.6
PO4	.030	--	<.030	--	<.030	--
SE	<.0010	--	--	--	--	--
SI	15.	--	--	--	--	--
SO4	1.0	--	1500.	--	1100.	--
SR	.40	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	.050	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 17B

TEST	SAMPLING DATE 820518	820519*	820825	820826*	821118	821119*
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	--	--	--	--	--	--
AL	--	--	--	--	--	--
ALKCO3	--	--	--	--	<5.0	--
ALKHCO3	--	--	1000.	--	860.	--
ALKOH	--	--	--	--	<5.0	--
ALKTOT	--	--	--	930.	--	850.
AS	--	--	--	--	--	--
B	--	--	<1.0	--	1.8	--
BA	--	--	--	--	--	--
BE	--	--	--	--	--	--
CA	--	--	120.	--	120.	--
CD	--	--	--	--	--	--
CL	--	--	79.	--	84.	--
CO	--	--	--	--	--	--
COND	--	--	180.	260.	170.	250.
CR	--	--	--	--	--	--
CU	--	--	--	--	--	--
F	--	--	--	--	--	--
FE	--	--	140.	--	90.	--
HG	--	--	--	--	--	--
K	--	--	20.	--	2.0	--
MG	--	--	52.	--	54.	--
MN	--	--	3.9	--	3.6	--
MO	--	--	--	--	--	--
NA	--	--	190.	--	170.	--
NI	--	--	--	--	--	--
NO3	--	--	--	--	--	--
PB	--	--	--	--	--	--
PH	--	--	6.8	6.6	6.9	6.6
PO4	--	--	<.030	--	.11	--
SE	--	--	--	--	--	--
SI	--	--	--	--	--	--
SO4	--	--	7.1	--	77.	--
SR	--	--	--	--	--	--
TH	--	--	--	--	--	--
TI	--	--	--	--	--	--
V	--	--	--	--	--	--
ZN	--	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 18A

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	--	--	--	--	--	--
ACID8.3	--	--	--	--	--	--
AG	.00020	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	<5.0	--	--	--	<5.0	--
ALKHCO3	61.	--	26.	--	7.0	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	100.	--	50.	--	20.
AS	<.0010	--	--	--	--	--
B	1.7	--	<1.0	--	2.7	--
BA	<.050	--	--	--	--	--
BE	<.00020	--	--	--	--	--
CA	140.	--	160.	--	240.	--
CD	.00010	--	--	--	--	--
CL	21.	--	21.	--	30.	--
CO	.0080	--	--	--	--	--
COND	130.	150.	180.	220.	230.	260.
CR	.0040	--	--	--	--	--
CU	.0040	--	--	--	--	--
F	<.20	--	--	--	--	--
FE	<.050	--	200.	--	230.	--
HG	.0032	--	--	--	--	--
K	2.2	--	4.0	--	5.1	--
MG	58.	--	73.	--	100.	--
MN	20.	--	41.	--	54.	--
MO	<.50	--	--	--	--	--
NA	51.	--	58.	--	75.	--
NI	.0080	--	--	--	--	--
NO3	3.0	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	6.5	6.6	5.8	6.6	5.0	6.4
PO4	.030	--	<.030	--	.051	--
SE	<.0010	--	--	--	--	--
SI	11.	--	--	--	--	--
SO4	680.	--	1300.	--	1700.	--
SR	.50	--	--	--	--	--
TH	.00020	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	.060	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000043

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 18B

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	120.	110.	--	--	--	--
ACID8.3	150.	--	--	--	--	--
AG	.00030	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	--	--	--	--	<5.0	--
ALKHCO3	--	--	56.	--	49.	--
ALKOH	<5.0	--	--	--	<5.0	--
ALKTOT	--	--	--	50.	--	70.
AS	<.0010	--	--	--	--	--
B	1.5	--	<1.0	--	2.3	--
BA	<.050	--	--	--	--	--
BE	.00060	--	--	--	--	--
CA	150.	--	140.	--	190.	--
CD	.00010	--	--	--	--	--
CL	22.	--	17.	--	18.	--
CO	.070	--	--	--	--	--
COND	180.	180.	130.	160.	160.	150.
CR	.0040	--	--	--	--	--
CU	.015	--	--	--	--	--
F	<.20	--	--	--	--	--
FE	13.	--	26.	--	11.	--
HG	<.00020	--	--	--	--	--
K	3.2	--	3.5	--	4.1	--
MG	64.	--	54.	--	69.	--
MN	34.	--	24.	--	32.	--
MO	<.50	--	--	--	--	--
NA	38.	--	55.	--	63.	--
NI	.026	--	--	--	--	--
NO3	.12	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	2.9	6.5	6.1	6.7	6.2	6.4
PO4	<.030	--	<.030	--	.045	--
SE	<.0010	--	--	--	--	--
SI	25.	--	--	--	--	--
SO4	890.	--	820.	--	920.	--
SR	.40	--	--	--	--	--
TH	<.00010	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	.14	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000047

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 19A

TEST	820518	820519*	820825	820826*	821118	821119*
			SAMPLING DATE			
ACID4.5	180.	150.	2900.	--	--	--
ACID8.3	610.	--	3300.	--	--	--
AG	.00090	--	--	--	--	--
AL	<1.0	--	--	--	--	--
ALKCO3	--	--	--	--	--	--
ALKHCO3	--	--	--	--	--	--
ALKOH	<5.0	--	--	--	--	--
ALKTOT	--	--	--	90.	--	--
AS	<.0010	--	--	--	--	--
B	1.6	--	<1.0	--	--	--
BA	<.050	--	--	--	--	--
BE	.00030	--	--	--	--	--
CA	280.	--	--	--	--	--
CD	.00020	--	--	--	--	--
CL	37.	--	48.	--	--	--
CO	.020	--	--	--	--	--
COND	340.	390.	2000.	420.	--	370.
CR	.0020	--	--	--	--	--
CU	.025	--	--	--	--	--
F	.20	--	--	--	--	--
FE	260.	--	--	--	--	--
HG	<.00020	--	--	--	--	--
K	3.1	--	--	--	--	--
MG	160.	--	--	--	--	--
MN	48.	--	--	--	--	--
MO	<.50	--	--	--	--	--
NA	180.	--	--	--	--	--
NI	.016	--	--	--	--	--
NO3	.030	--	--	--	--	--
PB	<.0020	--	--	--	--	--
PH	3.0	6.4	1.5	6.1	--	6.3
PO4	<.030	--	--	--	--	--
SE	<.0010	--	--	--	--	--
SI	23.	--	--	--	--	--
SO4	2400.	--	3500.	--	--	--
SR	.40	--	--	--	--	--
TH	.00020	--	--	--	--	--
TI	<1.0	--	--	--	--	--
V	<1.0	--	--	--	--	--
ZN	.10	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

000048

FUEL STORAGE AREA GROUNDWATER QUALITY TBTGS

LOCATION : 19B

TEST	820518	820519*	820825	820826*	821118	821119*
	SAMPLING DATE					
ACID4.5	--	190.	2900.	--	81.	--
ACID8.3	--	--	3100.	--	--	--
AG	--	--	--	--	--	--
AL	--	--	--	--	--	--
ALKCO3	--	--	--	--	--	--
ALKHCO3	--	--	--	--	--	--
ALKOH	--	--	--	--	--	--
ALKTOT	--	--	--	20.	--	--
AS	--	--	--	--	--	--
B	--	--	<1.0	--	1.6	--
BA	--	--	--	--	--	--
BE	--	--	--	--	--	--
CA	--	--	--	--	320.	--
CD	--	--	--	--	--	--
CL	--	--	16.	--	19.	--
CO	--	--	--	--	--	--
COND	--	300.	2000.	290.	320.	360.
CR	--	--	--	--	--	--
CU	--	--	--	--	--	--
F	--	--	--	--	--	--
FE	--	--	--	--	160.	--
HG	--	--	--	--	--	--
K	--	--	--	--	8.9	--
MG	--	--	--	--	140.	--
MN	--	--	--	--	62.	--
MO	--	--	--	--	--	--
NA	--	--	--	--	200.	--
NI	--	--	--	--	--	--
NO3	--	--	--	--	--	--
PB	--	--	--	--	--	--
PH	--	6.0	1.4	6.1	3.5	6.3
PO4	--	--	--	--	.039	--
SE	--	--	--	--	--	--
SI	--	--	--	--	--	--
SO4	--	--	1500.	--	2300.	--
SR	--	--	--	--	--	--
TH	--	--	--	--	--	--
TI	--	--	--	--	--	--
V	--	--	--	--	--	--
ZN	--	--	--	--	--	--

*TBTGS field data on fresh samples taken on the day before that shown.

APPENDIX B

POST-OPERATIONAL FUEL STORAGE AREA GROUNDWATER QUALITY STUDIES - 1982 THUNDER BAY TGS EXTENSION

ION BALANCES

AND

PIPER DIAGRAMS

000051

MAJOR ION CHEMISTRY

TBTGS FUEL
MAY 18 1982
TYPE - WATER

FUEL STORAGE AREA GROUNDWATER QUALITY- ION BALANCES

	CATIONS												CATION TOTAL	ANION TOTAL
	CA			MG			NA			K				
LOCATION	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM		
01A	76	3.79	45	32	2.63	31	44	1.91	23	2	.05	1	8.39	9.18
03A	71	3.54	54	29	2.39	36	15	.65	10	1	.04	1	6.62	7.31
04A	70	3.49	32	34	2.80	26	103	4.48	41	7	.17	2	10.94	12.72*
05C	223	11.12	56	76	6.26	32	54	2.35	12	3	.07	0	19.80	21.80
06B	180	8.98	57	59	4.86	31	41	1.78	11	3	.08	0	15.69	15.55
06C	133	6.63	50	51	4.20	32	55	2.39	18	3	.07	1	13.29	13.48
08B	117	5.84	58	39	3.21	32	22	.96	10	2	.04	0	10.04	11.25*
12C	290	14.46	61	94	7.74	33	29	1.26	5	2	.06	0	23.52	17.82*
13B	149	7.43	51	60	4.94	34	50	2.17	15	5	.14	1	14.68	15.94
13C	297	14.81	52	115	9.47	33	89	3.87	14	9	.24	1	28.38	9.52*
14A	450	22.44	41	280	23.05	42	220	9.57	17	4	.10	0	55.15	76.61*
14B	154	7.68	40	73	6.01	31	125	5.43	28	3	.09	0	19.21	23.79*
14C	123	6.13	40	42	3.46	22	132	5.74	37	2	.04	0	15.37	16.70
15A	239	11.92	52	117	9.63	42	24	1.04	5	10	.26	1	22.85	23.91
15B	189	9.43	54	80	6.58	38	29	1.26	7	2	.06	0	17.33	18.21
16A	84	4.19	44	52	4.28	45	22	.96	10	5	.13	1	9.56	11.22*
16B	217	10.82	56	92	7.57	39	22	.96	5	3	.07	0	19.42	20.11
17A	135	6.73	40	65	5.35	31	104	4.52	27	16	.41	2	17.01	19.04*
18A	141	7.03	50	58	4.77	34	51	2.22	16	2	.06	0	14.08	16.06*
18B	146	7.28	51	64	5.27	37	38	1.65	12	3	.08	1	14.28	19.08*
19A	276	13.77	39	160	13.17	38	184	8.00	23	3	.08	0	35.01	50.47*

* INDICATES ANION AND CATION TOTALS DON'T LIE WITHIN 10% OF EACH OTHER.

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- B-2 -

000052

MAJOR ION CHEMISTRY

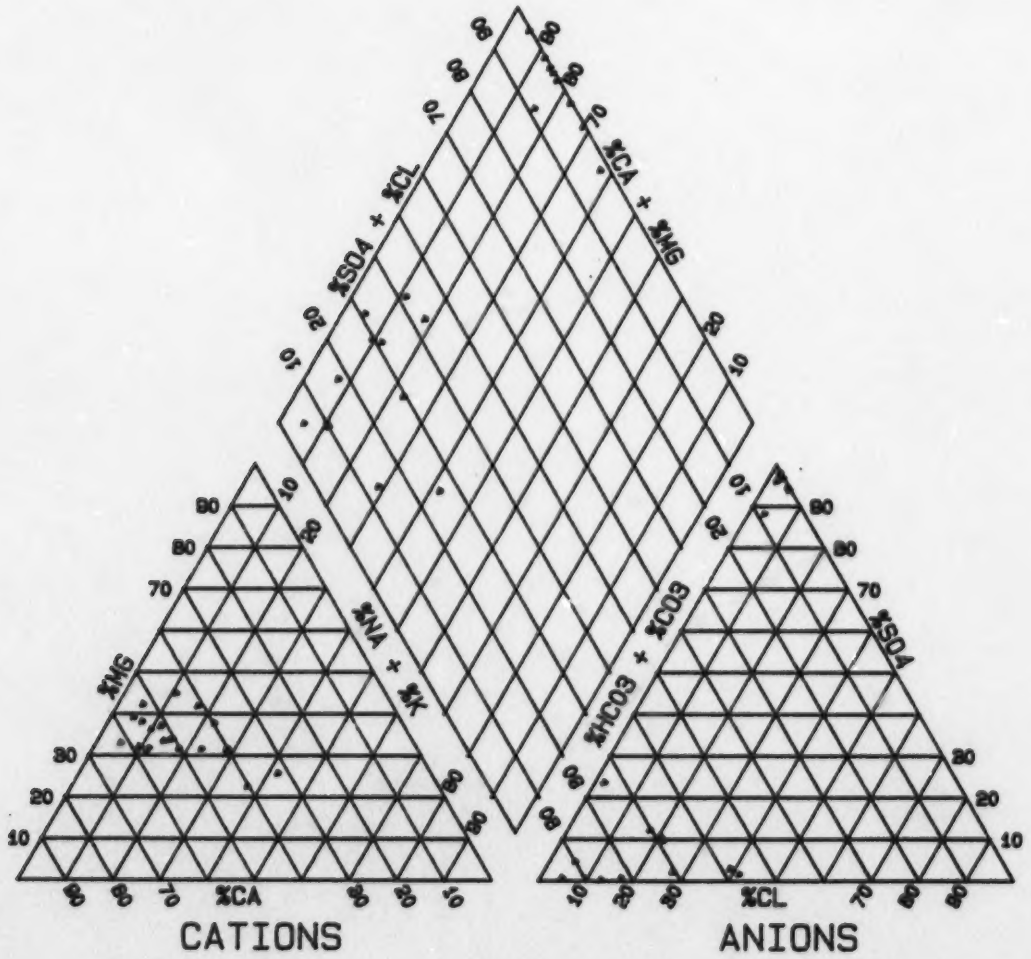
TBTGS FUEL
MAY 18 1982
TYPE - WATER

FUEL STORAGE AREA GROUNDWATER QUALITY- ION BALANCES

	ANIONS												ANION TOTAL	CATION TOTAL
	CL			SO4			HCO3			CO3				
LOCATION	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM		
01A	90	2.54	28	9	.19	2	388	6.36	69	3	.10	1	9.18	8.39
03A	15	.42	6	16	.33	5	346	5.68	78	26	.88	12	7.31	6.62
04A	11	.31	2	144	3.00	24	569	9.32	73	3	.10	1	12.72	10.94*
05C	169	4.76	22	101	2.10	10	905	14.84	68	3	.10	0	21.80	19.80
06B	217	6.11	39	21	.44	3	514	8.42	54	17	.58	4	15.55	15.69
06C	200	5.63	42	10	.21	2	427	7.00	52	19	.64	5	13.48	13.29
08B	71	2.00	18	66	1.37	12	475	7.78	69	3	.10	1	11.25	10.04*
12C	34	.96	5	810	16.86	95	0	.00	0	0	.00	0	17.82	23.52*
13B	19	.54	3	740	15.40	97	0	.00	0	0	.00	0	15.94	14.68
13C	21	.59	6	429	8.93	94	0	.00	0	0	.00	0	9.52	28.38*
14A	60	1.69	2	3600	74.92	98	0	.00	0	0	.00	0	76.61	55.15*
14B	17	.48	2	1120	23.31	98	0	.00	0	0	.00	0	23.79	19.21*
14C	14	.39	2	770	16.02	96	11	.18	1	3	.10	1	16.70	15.37
15A	42	1.18	5	6	.13	1	1372	22.49	94	3	.10	0	23.91	22.85
15B	113	3.18	17	5	.09	1	905	14.84	81	3	.10	1	18.21	17.33
16A	40	1.13	10	2	.04	0	608	9.96	89	3	.10	1	11.22	9.56*
16B	148	4.17	21	103	2.14	11	836	13.70	68	3	.10	0	20.11	19.42
17A	91	2.56	13	1	.02	0	998	16.36	86	3	.10	1	19.04	17.01*
18A	21	.59	4	680	14.15	88	74	1.22	8	3	.10	1	16.06	14.08*
18B	22	.62	3	887	18.46	97	0	.00	0	0	.00	0	19.08	14.28*
19A	37	1.04	2	2375	49.43	98	0	.00	0	0	.00	0	50.47	35.01*

* INDICATES ANION AND CATION TOTALS DON'T LIE WITHIN 10% OF EACH OTHER.

MAJOR ION CHEMISTRY
TBTGS FUEL
MAY 18 1982
TYPE - WATER
FUEL STORAGE AREA GROUNDWATER QUALITY- TBTGS



000654

MAJOR ION CHEMISTRY

TBTGS FUEL
AUG 25 1982
TYPE - WATER

FUEL STORAGE AREA GROUNDWATER QUALITY- ION BALANCES

	CATIONS												CATION	ANION
	CA			MG			NA			K			TOTAL	TOTAL
LOCATION	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM		
01A	83	4.14	44	36	2.96	31	54	2.35	25	2	.06	1	9.51	9.32
03A	120	5.99	49	56	4.61	38	36	1.57	13	3	.07	1	12.23	11.98
04A	116	5.79	47	54	4.44	36	41	1.78	15	7	.18	2	12.20	12.72
05C	220	10.97	54	83	6.83	34	54	2.35	12	4	.09	0	20.24	21.33
06B	194	9.68	55	68	5.60	32	50	2.17	12	3	.08	0	17.53	16.48
06C	240	11.97	52	105	8.64	38	54	2.35	10	3	.07	0	23.03	27.52*
07B	123	6.13	57	42	3.46	32	27	1.17	11	2	.04	0	10.81	10.17
08B	38	1.90	41	6	.49	11	50	2.17	47	3	.07	2	4.63	4.33
12C	244	12.17	57	62	5.10	24	92	4.00	19	10	.26	1	21.53	24.03*
13B	205	10.22	50	92	7.57	37	57	2.48	12	7	.17	1	20.45	29.04*
13C	190	9.48	51	80	6.58	35	56	2.43	13	6	.15	1	18.65	24.12*
14A	*270*	*13.47*	*31*	*248*	*20.41*	*48*	*206*	*8.96*	*21*	5	.12	0	42.95	83.37*
14B	236	11.77	42	100	8.23	29	184	8.00	28	6	.15	1	28.15	44.17*
14C	194	9.68	42	64	5.27	23	180	7.83	34	3	.07	0	22.84	27.32*
15A	200	9.98	54	84	6.91	38	33	1.43	8	2	.05	0	18.37	20.44*
15B	225	11.22	54	100	8.23	40	22	.96	5	9	.23	1	20.63	24.13*
16A	220	10.97	55	91	7.49	38	30	1.30	7	2	.06	0	19.82	20.91
16B	112	5.59	41	63	5.19	38	64	2.78	20	7	.18	1	13.73	15.90*
17A	312	15.56	46	122	10.04	29	192	8.35	24	8	.19	1	34.14	43.83*
17B	118	5.89	31	52	4.28	23	190	8.26	44	20	.51	3	18.94	22.37*
18A	164	8.18	49	73	6.01	36	58	2.52	15	4	.10	1	16.81	27.13*
18B	138	6.88	50	54	4.44	32	55	2.39	17	4	.09	1	13.81	18.66*
19A	0	.00	0	0	.00	0	0	.00	0	0	.00	0	.00	73.36*
19B	0	.00	0	0	.00	0	0	.00	0	0	.00	0	.00	32.71*

** INDICATES ANION AND CATION TOTALS DON'T LIE WITHIN 10% OF EACH OTHER.*

000055

MAJOR ION CHEMISTRY

TBTGS FUEL
AUG 25 1982
TYPE - WATER

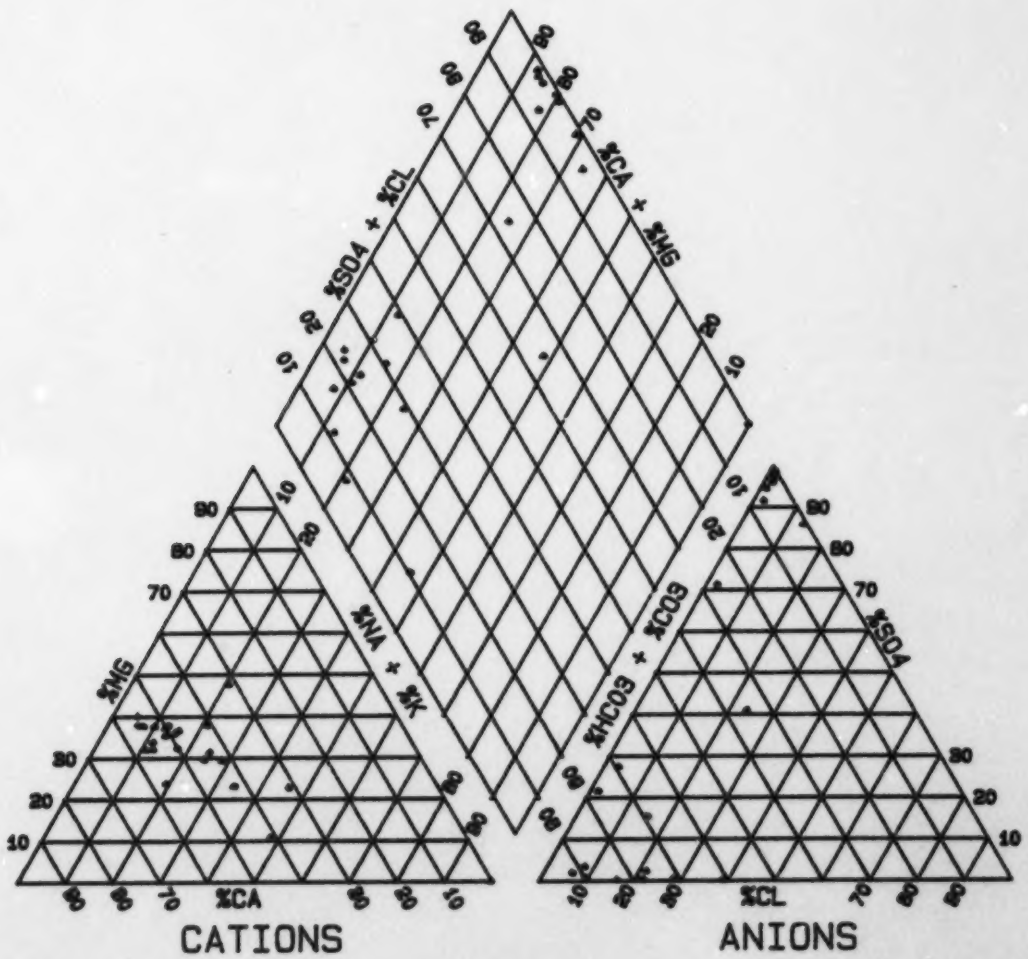
FUEL STORAGE AREA GROUNDWATER QUALITY- ION BALANCES

	ANIONS												ANION TOTAL	CATION TOTAL
	CL			SO4			HCO3			CO3				
LOCATION	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM		
01A	95	2.68	29	2	.04	0	403	6.60	71	0	.00	0	9.32	9.51
03A	35	.99	8	19	.40	3	647	10.60	88	0	.00	0	11.98	12.23
04A	16	.45	4	167	3.48	27	537	8.80	69	0	.00	0	12.72	12.20
05C	166	4.68	22	22	.46	2	988	16.20	76	0	.00	0	21.33	20.24
06B	230	6.48	39	0	.00	0	610	10.00	61	0	.00	0	16.48	17.53
06C	152	4.28	16	204	4.25	15	1159	18.99	69	0	.00	0	27.52	23.03*
07B	76	2.14	21	2	.03	0	488	8.00	79	0	.00	0	10.17	10.81
08B	37	1.04	24	85	1.77	41	93	1.52	35	0	.00	0	4.33	4.63
12C	118	3.32	14	990	20.60	86	6	.10	0	0	.00	0	24.03	21.53*
13B	20	.56	2	1350	28.10	97	23	.38	1	0	.00	0	29.04	20.45*
13C	19	.54	2	1110	23.10	96	29	.48	2	0	.00	0	24.12	18.65*
14A	54	1.52	2	3900	81.17	97	41	.68	1	0	.00	0	83.37	42.95*
14B	23	.65	1	2070	43.08	98	27	.44	1	0	.00	0	44.17	28.15*
14C	16	.45	2	1240	25.81	94	65	1.06	4	0	.00	0	27.32	22.84*
15A	122	3.44	17	0	.01	0	1037	16.99	83	0	.00	0	20.44	18.37*
15B	19	.54	2	250	5.20	22	1122	18.39	76	0	.00	0	24.13	20.63*
16A	166	4.68	22	2	.04	0	988	16.20	77	0	.00	0	20.91	19.82
16B	36	1.01	6	14	.29	2	891	14.60	92	0	.00	0	15.90	13.73*
17A	43	1.21	3	1500	31.22	71	695	11.40	26	0	.00	0	43.83	34.14*
17B	79	2.23	10	7	.15	1	1220	19.99	89	0	.00	0	22.37	18.94*
18A	21	.59	2	1250	26.01	96	32	.52	2	0	.00	0	27.13	16.81*
18B	17	.48	3	820	17.07	91	68	1.12	6	0	.00	0	18.66	13.81*
19A	48	1.35	2	3460	72.01	98	0	.00	0	0	.00	0	73.36	.00*
19B	16	.45	1	1550	32.26	99	0	.00	0	0	.00	0	32.71	.00*

*** INDICATES ANION AND CATION TOTALS DON'T LIE WITHIN 10% OF EACH OTHER.**

000056

MAJOR ION CHEMISTRY
TBTGS FUEL
AUG 25 1982
TYPE - WATER
FUEL STORAGE AREA GROUNDWATER QUALITY- TBTGS



83-442

000057

MAJOR ION CHEMISTRY

TBTGS FUEL
NOV 18 1982
TYPE - WATER

FUEL STORAGE AREA GROUNDWATER QUALITY- ION BALANCES

	CATIONS												CATION TOTAL	ANION TOTAL
	CA			MG			NA			K				
LOCATION	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM		
01A	73	3.64	43	32	2.63	31	49	2.13	25	3	.07	1	8.47	9.60*
03A	97	4.84	48	47	3.87	38	30	1.30	13	2	.05	1	10.06	11.40*
04A	82	4.09	44	42	3.46	37	34	1.48	16	8	.20	2	9.22	10.82*
05A	258	12.87	44	107	8.81	30	165	7.17	25	4	.11	0	28.96	31.09
06B	180	8.98	57	58	4.77	30	44	1.91	12	4	.09	1	15.75	17.88*
06C	248	12.37	57	87	7.16	33	47	2.04	9	3	.09	0	21.66	24.32*
07B	106	5.29	57	36	2.96	32	24	1.04	11	2	.05	1	9.34	10.10
08B	35	1.75	44	7	.58	14	37	1.61	40	3	.08	2	4.01	4.36
12C	348	17.36	62	100	8.23	29	49	2.13	8	8	.20	1	27.92	32.34*
13B	330	16.46	54	131	10.78	35	70	3.04	10	9	.23	1	30.51	46.69*
13C	261	13.02	51	110	9.05	36	72	3.13	12	9	.22	1	25.42	46.97*
14A	400	19.95	41	250	20.58	42	191	8.30	17	5	.13	0	48.96	74.67*
14B	200	9.98	41	89	7.33	30	165	7.17	29	6	.14	1	24.62	32.99*
14C	149	7.43	40	50	4.12	22	160	6.96	37	3	.07	0	18.57	21.05*
15A	200	9.98	55	80	6.58	37	32	1.39	8	2	.06	0	18.01	18.84
15B	245	12.22	58	98	8.07	38	14	.61	3	6	.16	1	21.06	22.50
16A	217	10.82	57	86	7.08	37	23	1.00	5	3	.07	0	18.98	20.25
16B	112	5.59	38	64	5.27	36	86	3.74	25	7	.19	1	14.78	16.61*
17A	293	14.61	46	117	9.63	30	166	7.22	23	9	.24	1	31.70	33.78
17B	118	5.89	33	54	4.44	25	175	7.61	42	2	.05	0	17.99	21.32*
18A	239	11.92	50	102	8.40	35	75	3.26	14	5	.13	1	23.71	36.46*
18B	195	9.73	53	69	5.68	31	63	2.74	15	4	.10	1	18.25	20.73*
19B	321	16.01	44	139	11.44	32	198	8.61	24	9	.23	1	36.29	48.40*

* INDICATES ANION AND CATION TOTALS DON'T LIE WITHIN 10% OF EACH OTHER.

83-442

MAJOR ION CHEMISTRY

TBTGS FUEL
NOV 18 1982
TYPE - WATER

FUEL STORAGE AREA GROUNDWATER QUALITY- ION BALANCES

	ANIONS												ANION TOTAL	CATION TOTAL
	CL			SO4			HCO3			CO3				
LOCATION	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM		
01A	100	2.82	29	2	.05	1	405	6.64	69	3	.10	1	9.60	8.47*
03A	44	1.24	11	3	.06	1	610	10.00	88	3	.10	1	11.40	10.06*
04A	13	.37	3	92	1.91	18	515	8.44	78	3	.10	1	10.82	9.22*
05A	900	25.35	82	4	.08	0	339	5.56	18	3	.10	0	31.09	28.96
06B	290	8.17	46	1	.02	0	586	9.60	54	3	.10	1	17.88	15.75*
06C	180	5.07	21	190	3.95	16	927	15.20	62	3	.10	0	24.32	21.66*
07B	66	1.86	18	1	.02	0	495	8.12	80	3	.10	1	10.10	9.34
08B	20	.56	13	94	1.96	45	106	1.74	40	3	.10	2	4.36	4.01
12C	40	1.13	3	1500	31.22	97	0	.00	0	0	.00	0	32.34	27.92*
13B	25	.70	2	2200	45.79	98	6	.10	0	3	.10	0	46.69	30.51*
13C	35	.99	2	2200	45.79	97	6	.10	0	3	.10	0	46.97	25.42*
14A	58	1.63	2	3500	72.84	98	6	.10	0	3	.10	0	74.67	48.96*
14B	16	.45	1	1550	32.26	98	11	.18	1	3	.10	0	32.99	24.62*
14C	20	.56	3	940	19.56	93	50	.82	4	3	.10	0	21.05	18.57*
15A	150	4.23	22	1	.02	0	884	14.50	77	3	.10	1	18.84	18.01
15B	20	.56	3	220	4.58	20	1053	17.25	77	3	.10	0	22.50	21.06
16A	160	4.51	22	35	.73	4	910	14.92	74	3	.10	0	20.25	18.98
16B	44	1.24	7	9	.18	1	921	15.10	91	3	.10	1	16.61	14.78*
17A	60	1.69	5	1100	22.89	68	555	9.10	27	3	.10	0	33.78	31.70
17B	84	2.37	11	77	1.60	8	1053	17.25	81	3	.10	0	21.32	17.99*
18A	30	.85	2	1700	35.38	97	9	.14	0	3	.10	0	36.46	23.71*
18B	18	.51	2	920	19.15	92	60	.98	5	3	.10	0	20.73	18.25*
19B	19	.54	1	2300	47.87	99	0	.00	0	0	.00	0	48.40	36.29*

* INDICATES ANION AND CATION TOTALS DON'T LIE WITHIN 10% OF EACH OTHER.

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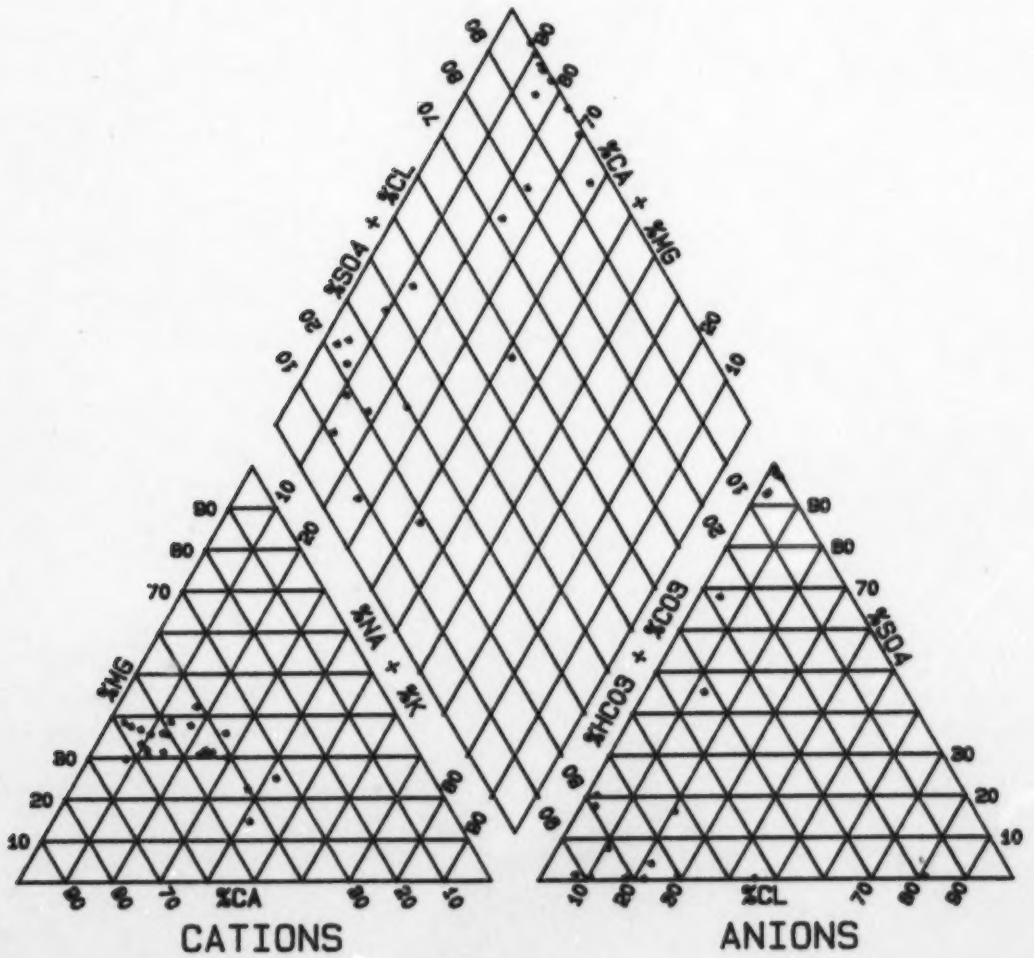
MAJOR ION CHEMISTRY
TBTGS FUEL
NOV 18 1982
TYPE - WATER
FUEL STORAGE AREA GROUNDWATER QUALITY- TBTGS



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